

AMERICAN MUSEUM NOVITATES

NUMBERS 899 TO 968



NEW YORK
PUBLISHED BY ORDER OF THE TRUSTEES
1937

EDITED BY
ETHEL J TIMONIER

CONTENTS OF AMERICAN MUSEUM NOVITATES

NUMBERS 899 TO 968

1937

- No. 899.—New and Little-Known American Bees. By T. D. A. Cockerell. 5 pp. January 8, 1937.
- " 900.—The Brain of the Swordfish (*Xiphias gladius*). By G. Miles Conrad. 4 pp. (Three text figures.) January 8, 1937.
- " 901.—Notes on Swordfish at Cape Breton, Nova Scotia. By J. T. Nichols and F. R. LaMonte. 7 pp. January 11, 1937.
- " 902.—Notes on the Alimentary Tract of the Swordfish (*Xiphias gladius*). By H. C. Raven and Francesca LaMonte. 13 pp. (Thirteen text figures.) January 11, 1937.
- " 903.—Rotifera from the Adirondack Region of New York. By Frank J. Myers. 17 pp. (Twenty-two text figures.) January 13, 1937.
- " 904.—Notes on the Genus *Sericornis* Gould. By Ernst Mayr. 25 pp. January 13, 1937.
- " 905.—Notes on the Taxonomy and Osteology of Two Species of *Mesoplodon*. (*M. europaeus* Gervais, *M. mirus* True). By H. C. Raven. 30 pp. (Fifteen text figures.) January 14, 1937.
- " 906.—New Hesperidae from the Antilles (Lepidoptera: Rhopalocera). By Frank E. Watson. 10 pp. January 16, 1937.
- " 907.—New Species and Records of Chinese Spiders. By Irving Fox. 9 pp. (Nine text figures.) February 13, 1937.
- " 908.—The Physiology, Life Cycles and Phylogeny of the Parasitic Flatworms. By Horace W. Stunkard. 27 pp. February 13, 1937.
- " 909.—Bees of the Genus *Sphecodes* from Saskatchewan. By T. D. A. Cockerell. 4 pp. February 25, 1937.
- " 910.—A New Bee from Chile. By T. D. A. Cockerell. 2 pp. February 25, 1937.
- " 911.—African Bees of the Genus *Heriades*. By T. D. A. Cockerell. 8 pp. February 25, 1937.
- " 912.—Birds Collected During the Whitney South Sea Expedition. XXXII. On a Collection from Tanna, New Hebrides. By Ernst Mayr. 4 pp. February 27, 1937.
- " 913.—Ten New Rodents from Angola, Africa. By John Eric Hill and T. Donald Carter. 10 pp. (Five text figures.) March 8, 1937.
- " 914.—New Genera and Species of Neotropical Hesperidae with Notes on Some Others. (Lepidoptera: Rhopalocera.) By E. L. Bell. 17 pp. (Seventeen text figures.) March 8, 1937.
- " 915.—Birds Collected During the Whitney South Sea Expedition. XXXIII. Notes on New Guinea Birds. I. By Ernst Mayr. 19 pp. April 10, 1937.
- " 916.—Two New Bats, *Eptesicus* and *Mops*, from Angola. By John Eric Hill. 3 pp. (One text figure.) April 17, 1937.

- No. 917.—Studies of Peruvian Birds. No. XXV. Notes on the Genera *Thamnophilus*, *Thamnocharis*, *Gymnophilys*, and *Ramphocaenus*. By John T. Zimmer. 16 pp. April 30, 1937.
- " 918.—Some Mineral Incrustations Selective upon Crystal Forms. By Clifford Frondel. 4 pp. (Two text figures.) May 1, 1937.
- " 919.—New American Lycosidae with Notes on Other Species. By W. J. Gertsch and H. K. Wallace. 22 pp. (Eighteen text figures.) May 1, 1937.
- " 920.—Description of a New Species of *Symphylurinus* (Insecta, Dicellura) from Central America. By Filippo Silvestri. 3 pp. (Three text figures.) May 3, 1937.
- " 921.—Two New Harvest Mice from Honduras. By George G. Goodwin. 2 pp. May 3, 1937.
- " 922.—Results of the Archbold Expeditions. No. 15. A New Fish of the Genus *Bostrychus* from New Guinea. By J. T. Nichols. 2 pp. (One text figure.) May 4, 1937.
- " 923.—Two New Tachinidae (Diptera) Parasitic on *Polybia* Species (Hymenoptera). By C. H. Curran. 4 pp. May 4, 1937.
- " 924.—Three New Species of *Tythonyx* from Cuba. By Andrew J. Mutchler. 5 pp. (Five text figures.) May 4, 1937.
- " 925.—Two Reversed Partially Ambicolorate Halibuts: *Hippoglossus hippoglossus*. By E. W. Gudger and Frank E. Firth. 10 pp. (Five text figures.) May 7, 1937.
- " 926.—The Neotropical Species of *Melanostoma* and Allies (Syrphidae: Diptera). By C. H. Curran. 4 pp. May 12, 1937.
- " 927.—New Reptiles from the Eocene of South America. By George Gaylord Simpson. 3 pp. May 12, 1937.
- " 928.—South American Bees. By T. D. A. Cockerell. 2 pp. June 2, 1937.
- " 929.—Records of African Bees. By T. D. A. Cockerell. 12 pp. June 11, 1937.
- " 930.—Studies of Peruvian Birds. No. XXVI. Notes on the Genera *Agriornis*, *Muscisaxicola*, *Myiotheretes*, *Ochthoeca*, *Colonia*, *Knipolegus*, *Phaeotriccus*, *Fluvicola*, and *Ramphotrigon*. By John T. Zimmer. 27 pp. June 24, 1937.
- " 931.—African Muscidae.—IV (Diptera). By C. H. Curran. 14 pp. June 29, 1937.
- " 932.—The Morphology of Wardite. By Frederick H. Pough. 5 pp. (Three text figures.) June 30, 1937.
- " 933.—Birds Collected During the Whitney South Sea Expedition. XXXIV. The Distribution and the Migration of the Long-Tailed Cuckoo (*Urodynamis taitensis* Sparrman). By Cardine Bogert. 12 pp. July 6, 1937.
- " 934.—*Syngnathus walcottii*, a New West Indian Pipefish. By J. T. Nichols. 1 p. July 7, 1937.
- " 935.—*Trichopepla klotsi*, a New Species of Pentatomid from Wyoming (Heteroptera). By Herbert Ruckes. 2 pp. July 7, 1937.
- " 936.—New American Spiders. By W. J. Gertsch. 7 pp. (Seven text figures.) July 13, 1937.

- No. 937.—New Insectivores, *Elephantulus* and *Crocidura*, from Angola, Africa.
By John Eric Hill and T. Donald Carter. 4 pp. July 13, 1937.
- " 938.—A New Species of Hesperiidæ, and Notes on Others, from Panama (Lepidoptera-Rhopalocera). By E. L. Bell. 7 pp. (One text figure.) July 20, 1937.
- " 939.—Birds Collected During the Whitney South Sea Expedition. XXXV. Notes on New Guinea Birds. II. By Ernst Mayr. 14 pp. July 21, 1937.
- " 940.—Additions to the Upper Paleocene Fauna of the Crazy Mountain Field. By George Gaylord Simpson. 15 pp. (Four text figures.) August 18, 1937.
- " 941.—New South American Syrphidae (Diptera). By C. L. Fluke, Jr. 14 pp. (Fifteen text figures.) August 18, 1937.
- " 942.—An Early Pleistocene Fauna from Nebraska. By Erwin H. Barbour and C. Bertrand Schultz. 10 pp. (Four text figures.) September 10, 1937.
- " 943.—A New Jurassic Mammal. By George Gaylord Simpson. 6 pp. (One text figure.) September 13, 1937.
- " 944.—An Albino Tarpon, *Tarpon atlanticus*, the Only Known Specimen. By E. W. Gudger. 4 pp. (Two text figures.) September 13, 1937.
- " 945.—A Glut Herring, *Pomolobus aestivalis*, with an Attached Colonial Hydroid, *Obelia commensuralis*. By E. W. Gudger. 6 pp. (Three text figures.) September 13, 1937.
- " 946.—On the Palate, Occiput and Hind Foot of *Bauria cynops* Broom. By R. Broom. 6 pp. (Three text figures.) September 14, 1937.
- " 947.—Birds Collected During the Whitney South Sea Expedition. XXXVI. Notes on New Guinea Birds. III. By Ernst Mayr. 11 pp. September 14, 1937.
- " 948.—Bees Collected in Arizona and California in the Spring of 1937. By T. D. A. Cockerell. 15 pp. September 27, 1937.
- " 949.—Siberian Bees of the Genera *Halictus sphecodes*, and *Hylaeus*. By T. D. A. Cockerell. 6 pp. September 27, 1937.
- " 950.—Bees of the Genera *Halictus* and *Ceratina* from Siam. By T. D. A. Cockerell. 12 pp. September 28, 1937.
- " 951.—A New Primate from the Upper Eocene Pondaung Formation of Burma. By Edwin H. Colbert. 18 pp. (Three text figures.) October 1, 1937.
- " 952.—The Comparative Osteology of the Swordfish (*Xiphias*) and the Sailfish (*Istiophorus*). By William K. Gregory and G. Miles Conrad. 25 pp. (Twelve text figures.) October 1, 1937.
- " 953.—More Complete Remains of a Chelonian, *Syllomus crispatus* Cope, from the Miocene of Virginia. By Charles T. Berry. 12 pp. (Three text figures.) October 7, 1937.
- " 954.—Notes on the Clark Fork, Upper Paleocene, Fauna. By George Gaylord Simpson. 24 pp. (Six text figures.) October 14, 1937.
- " 955.—The Skeleton of *Styracosaurus* with the Description of a New Species. By Barnum Brown and Erich M. Schlaikjer. 12 pp. (Five text figures.) October 30, 1937.

- No. 956.—A Gatun Ostracode Fauna from Cativa, Panama. By H. N. Coryell and Suzanne Fields. 18 pp. (Eighteen text figures.) November 1, 1937.
- " 957.—Results of the Archbold Expeditions. No. 17. Some Original Observations on the Habits of *Dactylopsila trivirgata* Gray. By A. L. Rand. 7 pp. November 1, 1937.
- " 958.—New Anthophorid Bees from California (Hymenoptera). By P. H. Timberlake. 17 pp. November 2, 1937.
- " 959.—A Pug-Headed Two-Lined Dab, *Lepidopsitta bilineata*, the Only Known Pug-Headed Flatfish. By E. W. Gudger. 5 pp. (Three text figures.) November 3, 1937.
- " 960.—Bees from Morocco. By T. D. A. Cockerell. 9 pp. November 3, 1937.
- " 961.—Report on a Collection of Spiders from Mexico. I. By W. J. Gertsch and L. Irby Davis. 29 pp. (Forty-four text figures.) November 10, 1937.
- " 962.—Studies of Peruvian Birds. No. XXVII. Notes on the Genera *Muscivora*, *Tyrannus*, *Empidonax*, and *Sirystes*, with Further Notes on *Knipolegus*. By John T. Zimmer. 28 pp. (One text figure.) November 18, 1937.
- " 963.—Studies of Peruvian Birds. No. XXVIII. Notes on the Genera *Myiodynastes*, *Conopias*, *Myiozetetes*, and *Pitangus*. By John T. Zimmer. 28 pp. November 18, 1937.
- " 964.—Eocene Mollusca from the Subathu Group (Lutetian) Simla Hills State, India. By H. E. Vokes. 13 pp. (Eight text figures.) November 19, 1937.
- " 965.—An Ancient Eusuchian Crocodile from Patagonia. By George Gaylord Simpson. 20 pp. (Three text figures.) November 29, 1937.
- " 966.—The Birds of the Sage West China Expedition. By Hugh Birkhead. 17 pp. December 4, 1937.
- " 967.—Notes on Carangin Fishes. By J. T. Nichols. 6 pp. December 4, 1937.
- " 968.—The Nasal Bone and Sword of the Sword Fish *Xiphias gladius*. By C. Miles Conrad. 3 pp. (Two text figures.) December 31, 1937.

The Title-page, Table of Contents, and Author Index to this volume of Novitates (Nos. 899 to 968, inclusive), published June 29, 1938.

The edition of Novitates is 1000. Copies are mailed on the date of issue, and the remainder of the stock is placed on sale in the Library.

AUTHOR INDEX

NOVITATES 899 TO 968

	NOVITATES No.
Barbour, Erwin H.....	942
Bell, E. L.....	914, 938
Berry, Charles T.....	953
Birckhead, Hugh.....	966
Bogert, Cardine.....	933
Broom, R.....	946
Brown, Barnum.....	955
Carter, T. Donald.....	913, 937
Cockerell, T. D. A.....	899, 909, 910, 911, 928, 929, 948, 949, 950, 960
Colbert, Edwin H.....	951
Conrad, G. Miles.....	900, 952, 968
Coryell, H. N.....	956
Curran, H. C.....	923, 926, 931
David, L. Irby.....	961
Fields, Suzanne.....	956
Firth, Frank E.....	925
Fluke, C. L., Jr.....	941
Fox, Irving.....	907
FrondeU, Clifford.....	918
Gertsch, W. J.....	919, 936, 961
Goodwin, George G.....	921
Gregory, William K.....	952
Gudger, E. W.....	925, 944, 945, 959
Hill, John Eric.....	913, 916, 937
LaMonte, Francesca.....	901, 902
Mayr, Ernst.....	904, 912, 915, 939, 947
Mutchler, Andrew J.....	924
Myers, Frank J.....	903
Nichols, J. T.....	901, 922, 934, 967
Pough, Frederick H.....	932
Rand, A. L.....	957
Raven, H. C.....	902, 905
Ruckes, Herbert.....	935
Schultz, C. Bertrand.....	942
Schlaikjer, Erich M.....	955
Silvestri, Filippo.....	920
Simpson, George Gaylord.....	927, 940, 943, 954, 965
Stunkard, Horace W.....	908
Timberlake, P. H.....	953
Vokes, H. E.....	964
Wallace, H. K.....	919
Watson, Frank E.....	906
Zimmer, John T.....	917, 930, 962, 963

AMERICAN MUSEUM NOVITATES

Number 899

Published by
THE AMERICAN MUSEUM OF NATURAL HISTORY
New York City

Jan. 8, 1937

NEW AND LITTLE-KNOWN AMERICAN BEES

BY T. D. A. COCKERELL

The holotypes of the new forms described below will be found in The American Museum of Natural History.

Camptopoeum semirufum, new species

FEMALE.—Length about 8.5 mm., anterior wing 7; head black, with dark green eyes, and a large yellow area on face, including large supraclypeal mark (about twice as broad as long), large dog-ear marks, upper half of clypeus with a median lobe of yellow extending downward in middle line, and lateral marks extending as broad bands from level of upper end of dog-ear marks to level of middle of clypeus, separated from eyes by a black line; antennae rather short, scape punctured, and with a yellow spot at base in front; flagellum red beneath except at base, the last joint highly polished and red above; third antennal joint about as long as next two together; head broader than long, face shining, occiput and cheeks with scanty hair, but face and front practically bare; mandibles with base broadly pale yellow, the apex acute; blade of maxilla broad and dark; maxillary palpi long and slender; tongue linear, extending some distance beyond maxillae; thorax with hardly any hair; tubercles yellow, prominent; mesothorax shining, finely punctured, with a pair of suffused red spots posteriorly, notauli long and distinct; except as stated, the prothorax and mesothorax are black, as also the pleura and sides of metathorax, but the scutellum, postscutellum, and greater part of metathorax (excepting a black line down middle) are clear red; these red parts are dull, and the base of the metathorax is not modified; tegulae red, the anterior part with a yellow triangle, pointed in front; wings reddish, darker apically; stigma of moderate size, ferruginous, nervures brown; basal nervure falling a little short of nervulus; two cubital cells, the first a little longer than the second, which receives both recurrent nervures, the first a considerable distance from the base, the second about half as far from apex; marginal cell long, somewhat obliquely truncate at end, and appendiculate; femora black, with front and middle knees broadly yellow; front tibiae yellow except at apex and on inner side, where they are red; middle tibiae with a large yellow area on basal half, the rest dusky red suffused with black; hind tibiae very much longer, rusty black, with long curled shining hairs, and light pubescence on inner face; front and middle tarsi red, hind tarsi black; hind basitarsi fully as long as the other joints together; abdomen dull, moderately shining and distinctly punctured on first tergite, which is entirely clear red; second tergite red, with a black triangular mark in middle, and a black spot at each side; third tergite mainly black, the anterior corners and the extreme sides red; fourth red with two very large crescentic transverse black marks, nearly meeting in middle; fifth black, the caudal tuft pale grayish brown; venter mainly black, but red at sides.

Texas: Brazos County, June 22, 1921 (Robert K. Fletcher). This

extraordinary bee was sent by Mr. F. F. Bibby to Mrs. Beulah Blair, who brought it to my attention. Dr. H. J. Reinhard kindly permits the specimen to be placed in the American Museum. The face-markings and general appearance at once suggest *Protandrena*, and I supposed it to be a new species of that genus, until I noticed that there were only two cubital cells. The genus *Camptopoeum* is new to North America except that Friese has recorded *C. prini* Holmberg from Costa Rica, a record so improbable that one suspects a mistake of some sort.

There is actually a good deal of resemblance to the Asiatic *C. rufiventre* Morawitz, which I have from Quetta, collected by Col. Nurse. But *C. rufiventre* is larger, with excessively large and broad facial foveae, these in *C. semirufum* being rather narrow, and shining. *C. ochraceum* Friese, from Argentina, is very different, with the antennae low down on the face, the clypeus short, and the orbits converging above. *C. maculatum* Spinola has a much smaller and more slender stigma. The various species at present assigned to *Camptopoeum* are conspicuously diverse, even after the removal of *Acamptopoeum* Cockerell, 1905 (*Lopocum* Friese, 1906), and no doubt some segregates (genera or subgenera) will be recognized when the group is critically revised.

The known species of *Camptopoeum* Spinola are twelve from the Palaearctic region (Spain and Algeria to Turkestan and Siberia), thirteen from South America east of the Andes, and twelve from Chile. In the western United States the genus known as *Spinoliella* Ashmead has many species. Unfortunately Ashmead designated as the type of *Spinoliella* the Chilean *Camptopoeum nomadoides* Spinola, an insect with black head and thorax, the abdomen red with white or very pale marks. Adequate comparisons have not been made, but it is improbable that *C. nomadoides* is congeneric with our North American insects.

***Andrena hemileuca* Viereck**

This species, very imperfectly described by Viereck, has been a source of difficulty (see 1914, Proc. U. S. National Museum, XLVIII, p. 30). At the Citrus Experiment Station I found a male determined by Viereck, from flowers of *Horkelia*, Sequoia Lake, California. I noted: face very broad; long black hair at sides of face and on scape; clypeus shining; mandibles long, red at tip; cheeks very broad, but not angulate (they should be angulate, according to Viereck's table, 1904, Can. Entom., XXXVI, p. 193); hair of thorax above long and tinged with ochreous; femora with much long white hair; wings dusky; stigma large, dark reddish; second cubital cell very narrow; basal nervure falling far short

of nervulus; abdomen shining, first two tergites with long white hair; hair at apex dark brown. This is not at all the same species as that from Colorado, described in the place cited (1914). The type of *A. hemileuca* is a female from Washington State.

***Andrena saccata* Viereck**

This is another species very imperfectly described by Viereck. I found a cotype, female, at the Citrus Experiment Station. Aspect of *A. carlini*; hair of head and pleura all black, of thorax above pale ochreous, becoming white in front; clypeus shining and distinctly punctured, without a ridge, region before apex with few punctures; process of labrum rather small, truncate; flagellum dark reddish, third joint about as long as next two together; metathorax with black hair; wings strongly dusky; stigma large, dull red; second cubital cell very broad, receiving recurrent nervure beyond middle; legs reddish; abdomen with erect black hair, abundant and conspicuous on first two tergites.

***Andrena porterae* Cockerell**

Timberlake takes this in California, on *Ribes*.

***Andrena mackieae*, new species**

FEMALE. -Length nearly 10 mm., anterior wing 7.4; black, including antennae, legs and the shining tegulae; hair of thorax above, and tubercles, ferruginous, rather short and stiff; face, cheeks and pleura with dull white hair, on vertex it is rusty black, but light on occiput; facial foveae, seen from above, chocolate color, not very broad, narrowly separated from eye; mandibles ordinary, the inner tooth small; malar space linear; process of labrum highly polished, with sloping sides, the end thickened; clypeus dull, with scattered punctures, and a median ridge, which in one view looks like a groove; third antennal joint as long as next two together; mesothorax dull, except the posterior disc, which is highly polished, as also is the scutellum; metathorax entirely dull and granular, the large triangular basal area poorly defined; wings somewhat dusky, the outer margin distinctly darkened; stigma large, dark reddish brown; nervures very dark; basal nervure meeting nervulus; second cubital cell small, square, or a little higher than broad, receiving recurrent nervure a little beyond the middle, about as far from second intercubitus as second recurrent from third; spurs pale reddish; legs with pale hair, hind knee-tuft and hair on inner side of hind basitarsi very dark gray; hind basitarsi broad and stout; scopa of hind tibiae compact, dark above at base, the hairs finely plumose; abdomen shining, duller at base, the surface minutely tessellate and with scattered excessively fine punctures, not visible under a lens; second tergite in middle with the apical depression about half as long as the raised part; tergites 2 to 4 with narrow conspicuous pure white hair bands, broadly interrupted on second, narrowly on third; apical tuft dark brownish gray, with white hair at sides; venter with white hair.

California: Live Oak Canyon, near Redlands, March 30, 1936 (Alice Mackie). In my manuscript table this runs to *A. brevipalpis* Cockerell, but differs by the white hair bands, the large dark stigma, and the black tegulae. From *A. trifasciata* Timberlake and Cockerell, it is known by the much narrower abdominal bands, the highly polished scutellum, and other characters. By the polished scutellum and hind part of mesothorax it is like *A. medionitens* Cockerell, but the abdominal bands and caudal tuft are quite different. I sent particulars of this species to Mr. R. H. Timberlake, but he writes that he has not found it. The pollen collected consists of spherical light yellow grains, not unlike that of *Artemisia*.

***Andrena harveyi* Viereck**

At the Citrus Experiment Station I examined a cotype from Corvallis, Oregon. Medium size, dull black, the face and abdomen somewhat shining; clypeus shining, closely punctured, strongly ridged; facial foveae broad and black; tegulae peculiar, black in front, the hind part red and produced; stigma dark red; second cubital cell higher than broad, receiving recurrent nervure far beyond middle; margins of tergites reddish; metathorax covered with long dull whitish hairs, including basal area.

A specimen determined by Viereck as *A. asmi* Viereck has the margins of tergites not reddish, but is conspecific with *A. harveyi*, as Timberlake had already determined. However, it is from Corvallis, and the type locality of *A. asmi* is Pullman.

***Andrena subaustralis* Cockerell**

Viereck had this as a subspecies of *A. erythrogastra* (Ashmead), the genitalia being the same. It has an extraordinary distribution, from California to Washington, D. C., where it was collected by Timberlake. I could not see any difference between specimens from the two coasts.

***Andrena lupinorum* Cockerell**

Nebraska: Harrison, July 2, 1936, female (John Player). New to Nebraska.

***Agapostemon coloradensis* Crawford**

***Agapostemon fasciatus* Crawford**

The names proposed by Crawford stand, and there is no valid basis for substituting those of Vachal, as given by Miss Sandhouse in 1936, Jour. Washington Acad. Sci., XXVI, pp. 77 and 78. I think *A. fasciatus* is a valid species; I have cotypes of both sexes from Crawford.

***Halictus ovaliceps* Cockerell**

Colorado: Ouray, approx. 8500 ft., July 11-14, 1919 (Pearce Baily, Jr.). New to Colorado. The altitudinal range is remarkable, as Hicks found it at Pasadena, California (1936, *Canad. Entom.*, p. 47).

***Melissodes habilis* Cockerell**

Colorado: Florissant, July 11, 1936 (Cockerell). Male at white thistle (*Cirsium*) flowers. The hitherto unique type (in the American Museum) was taken by Wickham at Colorado Springs. The new specimen differs in a few details: the clypeal yellow is pale lemon-color, eyes black, hair of head and thorax above fulvescent, third cubital cell about as broad above as second; light band on fourth tergite almost obsolete. It remains to be seen whether these characters are constant in Florissant specimens, which come from a higher altitude and considerably cooler climate.

***Sphecodes arvensiformis* Cockerell**

Colorado: South Fork of Rio Grande, June 17, approx. 8200 ft., one female (F. E. Lutz) at approx. 8500 ft., one female at light (F. E. Lutz). New to Colorado.

AMERICAN MUSEUM NOVITATES

Number 900

Published by
THE AMERICAN MUSEUM OF NATURAL HISTORY
New York City

Vol. 8, 1937

THE BRAIN OF THE SWORDFISH. (*XIPHIAS GLADIUS*)

By G. MILNE'S CONRAD

The swordfish brains used in this study were collected by the Lerner Cape Breton Expedition of The American Museum of Natural History at Louisburg, Nova Scotia. In a fish of the average length of eleven feet from the tip of the sword to the notch of the caudal fin the brain would measure about $1\frac{5}{16}$ inches in length and $\frac{7}{8}$ inch wide across the optic lobes.

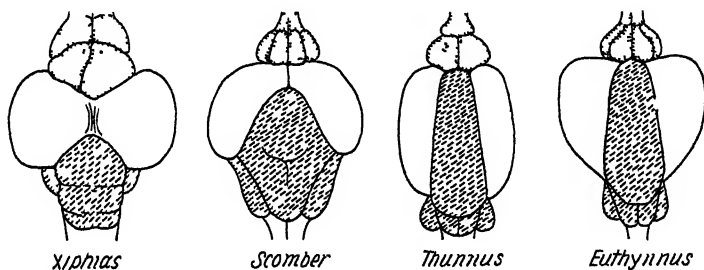


Fig. 1 Comparative series of scombriform brains, showing the relative sizes of the cerebellum (oblique broken lines) and the forebrain (stippled) in *Xiphias*, *Scomber*, *Thunnus* and *Euthynnus*. *Scomber*, *Thunnus* and *Euthynnus* are redrawn from Kishinouye

In keeping with the evolutionary tree of the scombriform fishes as proposed by Gregory (1933, p. 318, Pl. 1), it may be noted that the brain of *Xiphias* compares more favorably with that of *Scomber* than with that of *Thunnus* or its allies.

A dorsal view of the brain of *Xiphias* (Fig. 2A) shows an almost typical teleost brain. The cerebellum is of an "oblong" form extending from the medulla oblongata over about one-third of the optic lobes. As in the tuna and the mackerel the surface of the cerebellum is grooved. The scombriform brains figured by Kishinouye show in almost every case the cerebellum reaching from the medulla to the forebrain. In *Thunnus germon* the length of the cerebellum is 73 per cent of the whole; in *Scomber*, 57 per cent; and in *Xiphias* it is 38 per cent (Fig. 1).

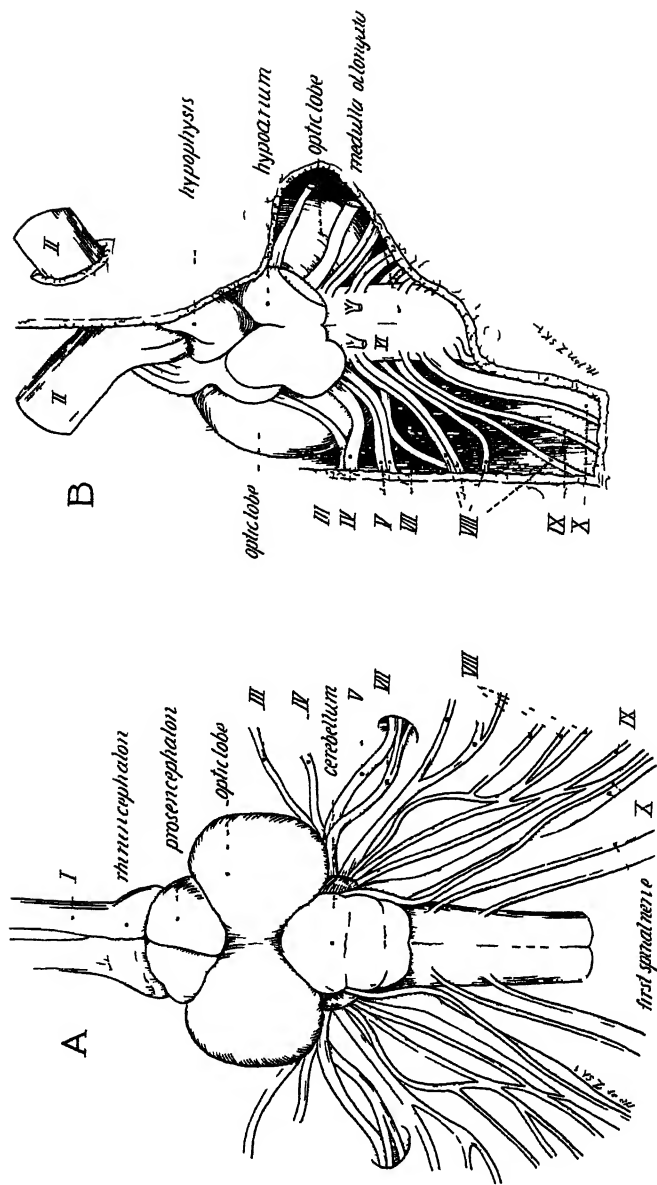


Fig 2A. Dorsal view of the brain of *Xiphias*. 2B. Ventral view of the brain of *Xiphias*

The optic lobes, while well developed, are not exceptional when compared with other scombriform brains. The pineal body, or epiphysis, is apparently absent or greatly reduced. Many figured brains of teleosts, including those of Kishinouye in his study of the scombroïd fishes, appear to lack this element, so that its absence or reduction in *Xiphias* is not unusual.

The forebrain is relatively large and, judging from Kishinouye's figures (1923, p. 352), is very large for the group. It constitutes about 35 per cent of the length and 51 per cent of the greatest width of the entire brain in *Xiphias*; in *Scomber* the proportions are: length, 25 per cent, width, 46 per cent; in *Thunnus germo*, length, 20 per cent, width, 43 per cent; and in *Euthynnus yaito* the length is 25 per cent and the width is 38 per cent of the whole (Fig. 1). This large size suggests a superior olfactory sense.

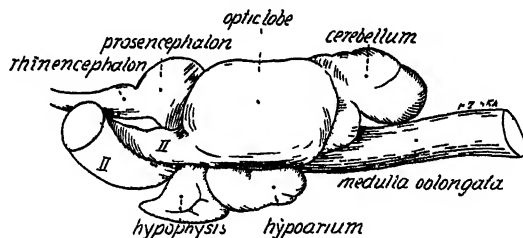


Fig. 3. Lateral view of the brain of *Xiphias* with the cranial nerves removed.

The most noticeable difference between the brain of *Xiphias* and that of the tuna, as figured by Kishinouye, is the relatively small cerebellum of the former. That the size of the cerebellum is correlated with the muscular activity of the animal seems borne out by this, for the tuna is a very active fish at all times, while the swordfish often floats sluggishly about near the surface and does not seem capable of prolonged action. The mackerel, whose cerebellum is somewhat larger than that of *Xiphias*, approaches the tuna in activity.

The ventral aspect of the brain (Fig. 2B) is notable for its prominent inferior lobes, or hypoaria, and for the large hypophysis. The pituitary body in *Xiphias* forms a triangular wedge, which forces its way between the anterior ends of the hypoaria. Ventrally the hypophysis tapers to a conical apex (Fig. 3), as contrasted with its almost spherical contour in

Scomber as figured by Allis (1903, Pl. xii). As in the mackerel no saccus vasculosus was found.

The cranial nerves seem to be easily homologized with those of the typical teleost complex.

REFERENCES TO LITERATURE

- ALLIS, E. P. 1903. 'The skull and the cranial and first spinal muscles and nerves in *Scomber scomber*.' Jour. Morph., XVIII, No. 2, pp. 45-328.
- GREGORY, WILLIAM K. 1933. 'Fish skulls: a study of the evolution of natural mechanisms.' Trans. Amer. Philos. Soc., N.S., XXIII, No. 2, pp. 75-481.
- HERRICK, C. J. 1899. 'The cranial and first spinal nerves of *Menidia*; a contribution upon the nerve components of the bony fishes.' Jour. Comp. Neur., IX, Nos. 3, 4, pp. 153-455.
- KISHIMOTO, K. 1923. 'Contributions to the comparative study of the so-called scombroid fishes.' Jour. Coll. Agriculture, Imp. Univ. Tokyo, VIII, No. 3, pp. 293-475.
- MEADER, R. G. 1934. 'The optic system of the teleost, *Holocentrus*. 1. 'The primary optic pathways and the corpus geniculatum complex.' Jour. Comp. Neur., LX, No. 3, pp. 361-407.
- OWEN, R. 1866. 'Anatomy of Vertebrates. Vol. I, Fishes and Reptiles.' London. 1866.

AMERICAN MUSEUM NOVITATES

Number 901

Published by
THE AMERICAN MUSEUM OF NATURAL HISTORY
New York City

Jan. 11, 1937

NOTES ON SWORDFISH AT CAPE BRETON, NOVA SCOTIA

BY J. T. NICHOLS AND F. R. LAMONTE

INTRODUCTION

Louisburg, Cape Breton Island, is the seat of an important swordfish fishery. Swordfish (*Xiphias gladius*) were abundant off this port when we visited it from July 28 to August 25, 1936, with the Michael Lerner-Cape Breton Expedition, on a good day over 300 fish being landed there. They were taken from some twenty to thirty miles offshore to close inshore, not more than a mile or two from the coast line.

In addition to exhibition material desired by The American Museum of Natural History, we obtained considerable data on swordfish and familiarized ourselves with certain problems concerning the habits of the species, here discussed.

FEEDING HABITS

The swordfishing season at Louisburg is between the latter part of July and early October. Although fish weighing as little as 60 lbs. dressed are said to have been brought in, the average weight is around 265 lbs. dressed.

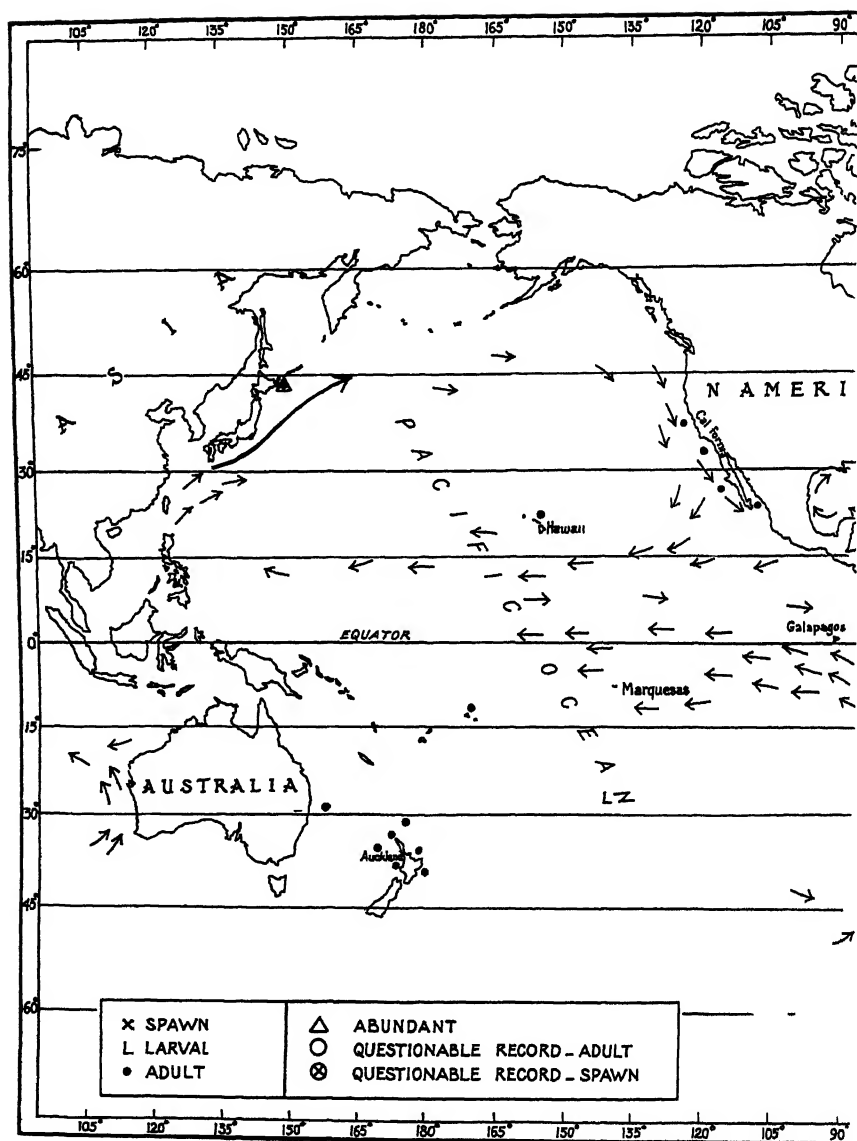
The fish are taken with the harpoon while swimming lazily, resting at the surface, commonly with the dorsal fin and the upper lobe of the caudal projecting above the water. They are usually met with thus on sunny days with little wind, and it is on such days that the big takes are made. In overcast, windy weather few are seen or captured.

These habits of the swordfish are well known, and will be found in almost any discussion of the species.¹ Their significance, however, seems to have been quite generally overlooked. We examined stomachs of numerous swordfishes landed at Louisburg, and found all of them from half full to jammed with food. Presumably the fish loafs at the surface when it has fed, idleness and relative warmth aiding digestion. When located, such fish may be tempted to strike at a bait, but they are not actively feeding.²

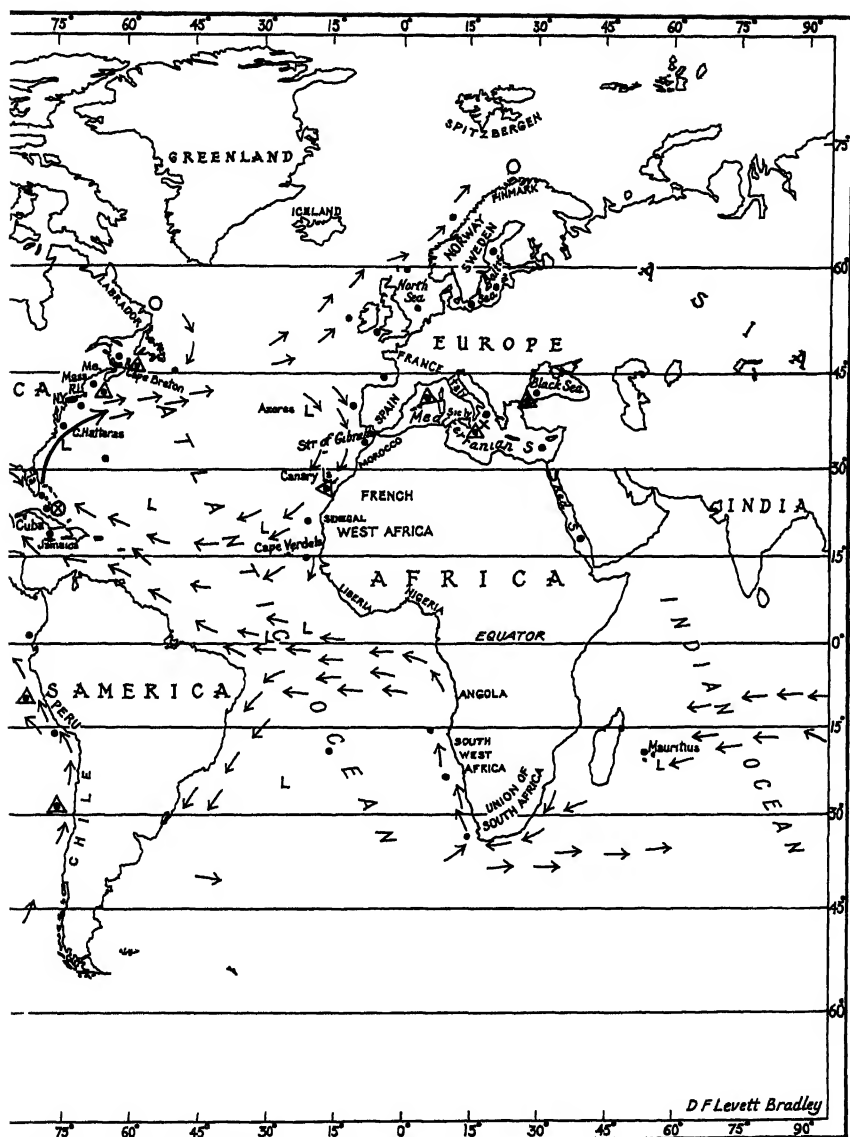
There is no question that the swordfish were off Louisburg to feed on schools of herring. All but a small part of the stomach contents ex-

¹ Bigelow and Welch, 1925, Bull. U. S. Bur. Fish., XL, pt. 1, p. 225. Goode, 1888 'Amer. Fishes,' p. 242.

² Lehmann, 1935, in 'Amer. Big Game Fishing,' p. 138.



Swordfish distribution and



ocean currents (arrows)

amined consisted of herring so far as determinable; many were large herring with roe. Exceptions are the stomach of one large fish (dressed weight 520 lbs.) which contained about 12 herring and one whole dogfish (*Squalus*), and that of a small one which held three large herring, a whole 12-inch squid and fragments of two or three other squids. This individual was the only swordfish on which really distinct lamprey marks were noticed,¹ and its herring were unusually fresh and little digested, details which may be evidence of its having just come in from other grounds. Single squid were also found among the usual herring in a specimen of 248 lbs. dressed weight, on August 21, and in one of 495 lbs. dressed weight on August 22.

The swordfish belongs to a warm water tribe, and, other things being equal, might be expected to remain in comparatively warm water. It presumably invades the Georges-Nova Scotia area in summer to feed on the northern schooling fish and squid found there. When it has fed, it might reasonably be supposed to seek the warmest water available to digest its meal, and that it does so seems to be the case.

It is the generally accepted belief among fishermen that the normal manner of feeding of the swordfish is to strike into schools of smaller fishes, killing and disabling them with its sword and then picking up the victims.² This would not be an easy habit to observe; impossible except where swordfish are feeding at the surface. That it does not always pertain is evidenced by Mr. Lerner's success in getting swordfish, sighted at the surface, to strike at a trolled mackerel bait. That it may well be their general habit is favored by the circumstantial evidence. Their sword supplements a rather inadequate oral equipment for a predaceous fish, and the species commonly found in their stomachs are close-schooling forms.

SPAWNING HYPOTHESIS

The adult swordfish is a temperate zone species, although sufficiently tolerant of temperature variations to occur in small numbers from the tropical waters of Florida to the subarctic waters of Newfoundland or even Labrador.³ Its pelagic, more or less drifting larval stages, on the other hand are very likely confined to warmer water, as are the swordfish's relatives. One excellent reason why swordfish that abound on the Georges-Nova Scotia banks in summer do not spawn there at the

¹ We found no remoras on swordfish examined, nor external parasites, with the exception of a parasitic copepod, *Pennella flosa* (L.) observed several times.

² Bigelow and Welsh, *loc. cit.*, p. 225.

³ A Cape Breton swordfish fisherman reported seeing swordfish off Labrador, and that the Eskimos found them plentiful there—an interesting observation which we believe requires corroboration.

season when Mediterranean individuals are thought to spawn may be that their young would not thence readily reach any suitable ocean basin. Even did they get into the western edge of the Gulf Stream drift, they would be carried northeastward to unsuitable latitudes.

Swordfish on the American coast in summer have inactive gonads. The fish are there because they find it a favorable feeding ground, and as the season advances they become fatter and better nourished. The ensuing fall or winter would be the logical time for them to spawn, and it is presumably the time that they do spawn—but where? On this point there is little evidence, and much of it negative, but such as it is points to the Canaries Current off the west coast of Africa. The scarcity off our coast of small swordfish of only a few pounds weight, such as occur in the Mediterranean, indicates that there is no nursery ground in the western side of the Gulf Stream drift, as there should be if the species spawned in the Western Atlantic. Moreover, a spawning ground off Africa would provide warm temperate water for the parent fish, whence the drift would be toward a suitable tropical basin for the young. Finally, this would place the unknown spawning ground of the American fish adjacent to the known spawning ground of the European, with a spawning season from winter to summer northward, dependent on latitude, such as fishes frequently show on a long stretch of coast.

THE BANKS

Cape Breton seems to be the most northeasterly point on our coast where swordfish are abundant. They are equally, or more abundant on Georges Bank and are found westward to the east end of Long Island in smaller numbers. A few also occur in the Gulf of Maine.

For purposes of discussion, zoögeographers divide the land into faunal areas over which physical conditions and the resulting aspects of life are comparatively uniform. Perhaps it is the sameness of the unfamiliar which has prevented the seas' being classified in like manner or to the same extent. We believe it would be advantageous to consider waters of the continental shelf from Georges Bank to Cape Breton Island a unit faunal area, which might be known as the Georges-Nova Scotia shelf. Ten to twenty miles off Louisburg, the green water with drifting rockweed looks much the same as Georges Bank to man or to swordfish. This area is cold in winter and with relatively warm surface water in summer, warmer than the immediate shore waters of the Gulf of Maine where tides in the Bay of Fundy and prevailing offshore winds farther south bring the colder, deeper strata to the surface.

At any season, abruptly warmer temperatures in the Gulf Stream drift skirt the outer southeast edge of the Georges-Nova Scotia shelf, but, due to oceanographic barriers, these warmer waters invade it little. The principal outside influences are in intermittent currents which circle the Gulf of Maine from the east or northeast. These are warm in summer and fall, and as they reach the northeast end of the area most directly they tend to compensate for latitude and make it a unit physically separable from Newfoundland banks by relatively warmer summer surface temperatures. They are, however, cold in winter and spring, wiping out any such considerable temperature break with the subarctic.¹

As regards the relation of Louisburg to this faunal area, we were there at a date when impingement of warmer, offshore surface water on the coast could be observed. From July 29 to August 1, there was a band of surface water of some 55° F. along the coastline, extending at least five miles offshore on the former date. Harbor temperatures, presumably from local warming were around 60°, and temperatures ten to twenty miles offshore also around 60°. Strong westerly currents along the shore reported for two or three days after a full moon on August 2 seem to have been correlated with obliteration of this belt of cold water. On August 4, the temperature just outside Louisburg was 60°; close to Scatari Island, 63°; on August 6, it was 65° just outside and 66° some five miles offshore; still 60° well inside the harbor. Between August 8 and August 25, inshore temperatures varied from 59° to 68°; on August 13 and 14, those fifteen to forty miles offshore were 68° to 69°.

The strictly shore fauna was very limited. Cunners (*Tautoglabrus adspersus*) were plentiful about the weed-grown piles of the docks, and a few eels and sticklebacks were present, but surprisingly few species were noticed and the large amount of swordfish waste going overboard each day was not being utilized. Very likely, summer temperatures are too high for cold-water fishes, and the long stretch of cold shore of the Gulf of Maine a barrier to those for which these temperatures would be appropriate, although we know that numerous southern species straggle across the banks to Nova Scotia.² One may say that the Georges-Nova Scotia bank faunal area comes quite up to the shore here, as it does not farther south. Among summer surface species characteristic of it, we observed, other than the swordfish, the blue shark (*Prionace glauca*), which seemed to be common, and the black rudder fish (*Palinurichthys perciformis*). Of offshore birds there were a few red phalaropes

¹ Bigelow and Welch, 1928, Bull. U. S. Bur. Fish., XL, pt. 2.

² Vladykov and McKenzie, 1935, 'Marine Fishes of Nova Scotia,' Proc. Nov. Scot. Inst. Sci., XIX, pt. 1.

in gray plumage, and a few procellariiformes, greater and sooty shearwaters and the Wilson's petrel, but not the Leach's petrel. A school of blackfish and a little piked whale were seen; two porpoises, a *Phocaena* and *Lagenorhynchus acutus* were brought in. *Phocaena* is probably less numerous than in colder waters; the whale and the other porpoise are very likely characteristic of this area.

The rockweed along the shore was not particularly luxuriant, and only a little was cast up along the beaches. This was evidently of local origin as was also a little drifting along the coast line. In such drifting weed a small amphipod, *Calliopius laeviusculus* (Kröyer), abounded, and nothing else was found. The same amphipod was abundant in weed growing in shallow water. Ten or twenty miles offshore, drifting rockweed became much more plentiful, and it would be interesting to know its place of origin. The luxuriant growth of this weed on the tide-swept shores of the Gulf of Maine presumably accounts for its abundance on Georges Bank.

AMERICAN MUSEUM NOVITATES

Number 902

Published by
THE AMERICAN MUSEUM OF NATURAL HISTORY January 11, 1937
New York City

NOTES ON THE ALIMENTARY TRACT OF THE SWORDFISH (*XIPHIAS GLADIUS*)

By H. C. RAVEN AND FRANCESCA LAMONTE

Through the generosity of Mr. Michael Lerner, The American Museum of Natural History was able to send some members of the Department of Fishes and the Department of Comparative Anatomy to Louisburg, Nova Scotia, where a laboratory was established for studies on the anatomy, food habits and other data relating to the marine fauna, particularly the swordfish.

It was thus our privilege to examine a number of fresh swordfish. We failed to find any recent literature on the visceral anatomy of this fish, but we did, however, find a very good account of its anatomy by R. E. Grant¹ published in 1828 and we here corroborate, in the main, his findings.

Louisburg, Cape Breton Island, at the northeastern extremity of Nova Scotia, is the principal Canadian swordfishing ground. The fish are harpooned at the surface of the sea from small motor and sail sloops, mostly during July and August, and shipped on ice from Louisburg to Boston and thence to the markets of the United States.

As most of the dissection was made on one specimen, we give below some of its measurements:

Total weight	225 lbs.
Length to notch of caudal fin	106 1/2 ins. = 270 cm.
Tip of sword to anterior edge of eye	39 " = 101 cm.
Remainder of head	13 " = 33 cm.
Diameter of eye	3 " = 7.5 cm.
Greatest depth of body behind first dorsal	18 " = 45 cm.
Greatest thickness of body behind first dorsal	11 " = 29 cm.
Tip of lower jaw to angle of gape	9 1/2 " = 24 cm.

The swordfish is a powerful, fast, predatory fish of the tropical and temperate open seas. It is a highly specialized relative of the mackerels. The food of the specimens we examined consisted chiefly of herring (*Clupea harengus*) but also of dogfish (*Squalus acanthias*) and the northern squid (*Ommastrephes illecebrosus*).

¹ 1828, Trans Med-Chir Soc. Edinburgh, III, pp 79-93.

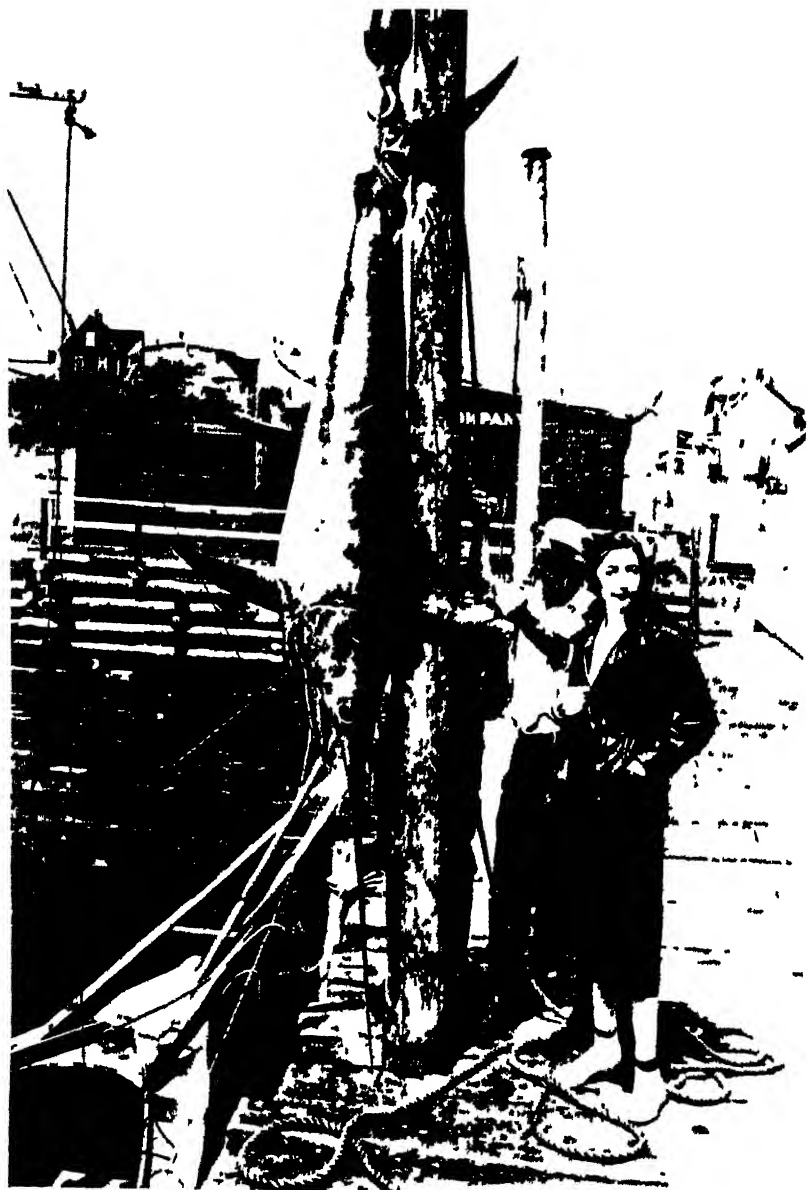


Fig. 1. Swordfish caught off Louisburg, Nova Scotia.

The swordfish is said to secure herring by swimming swiftly into a shoal of them and striking right and left with its sword, then darting about swallowing any that may have been disabled. During our examination of stomach contents of the swordfish the remains of a number



Fig. 2. Mouth of the swordfish, showing pointed mandible and jaws lacking teeth.

of herring which had apparently been mutilated before being swallowed were seen. The majority, however, showed no injury and had been engulfed whole, probably without having first been struck by the sword.

The swordfish has evolved beyond the mackerels in its digestive system, just as it is more specialized than the mackerels in its skeletal and other characters.

The mouth of the swordfish is relatively small and its bony framework delicate compared with the smaller mackerels. Its jaws are entirely devoid of teeth such as are found in mackerels, though the inside of the mouth and the oral surfaces of the gill arches are covered with fine, backwardly directed denticles which help in holding its prey, which



Fig. 3. The stomach, a long blind pouch, with a large oesophageal opening and a small pyloric opening close to it.

is of small size. The mouth and oesophagus of the swordfish are well supplied with mucous glands and much slime was always found there.

The mucous membrane of the very short oesophagus is smooth and arranged in a series of longitudinal folds when in its usual closed condition. The sphincter that surrounds the oesophagus is very strong, nearly a centimeter in thickness by 5 cm. caudo-rostrally, and composed of coarse red circular fibers externally. Beneath the circular fibers are longitudinal fibers, also coarse and red.

The stomach (Fig. 3), which had the shape of a long narrow flask, was widest at the middle and tapered toward the ends. It measured 25 ins. (= 63 cm.) in length and $8\frac{1}{2}$ ins. (= 21 cm.) in width, and hung free in the left side of the body cavity, being capable of extension when filled with food to a position nearly as far caudal as the vent. The proxi-

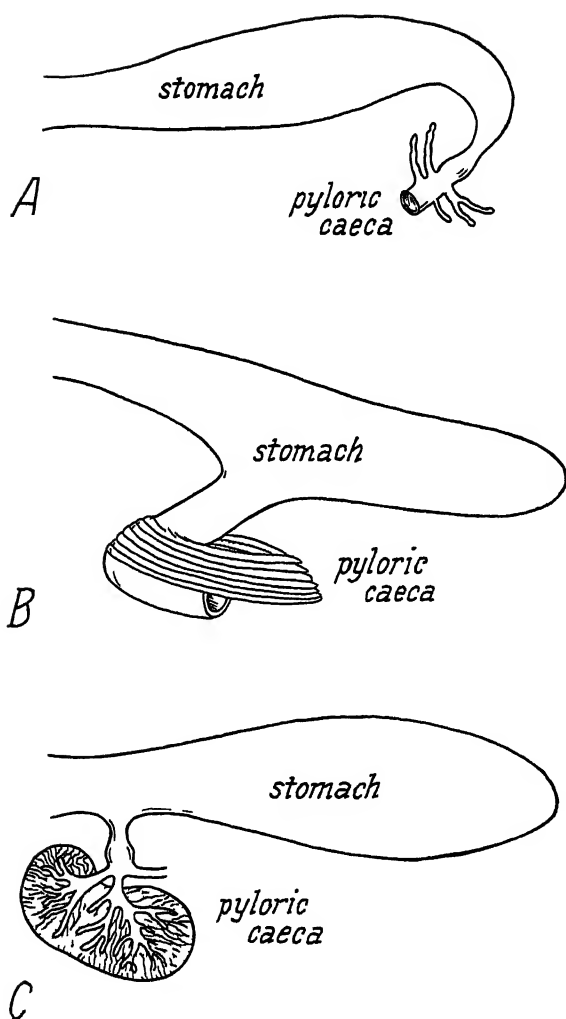


Fig 4. Outline of the stomach and pyloric caeca in: A, less specialized bony fish; B, a mackerel; and C, the swordfish.

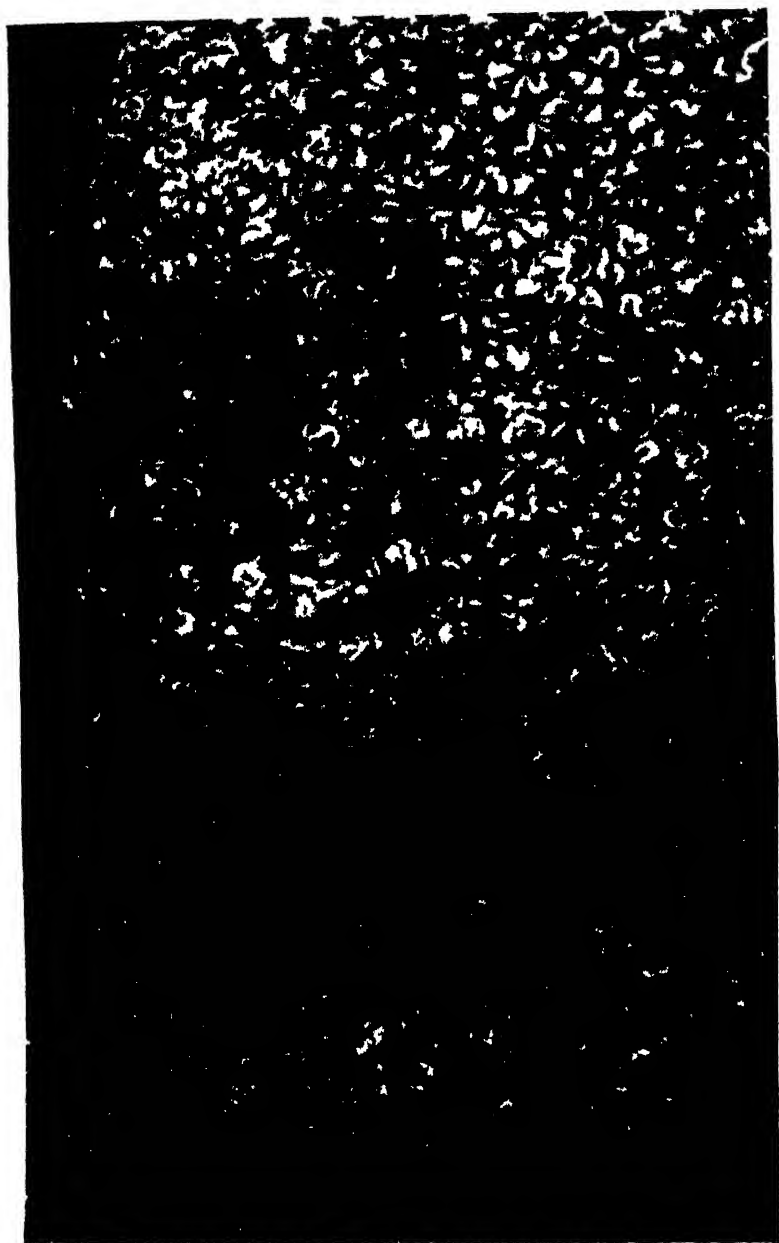


Fig. 5. The lining of the stomach in the swordfish.

mal half of the stomach occupied a sulcus formed by the liver rostrally and the pyloric caeca caudally.

A comparison of the stomach of a more primitive bony fish, such as a salmon, with that of a mackerel and the swordfish indicates how the stomach of the latter evolved. In figure 4A the stomach is scarcely more than a slightly enlarged tube but in B, the mackerel, the fundus has elongated and the pylorus is relatively nearer the oesophageal opening; in C the same process has been carried still farther, so the stomach here appears mainly as a blind pouch.



Fig. 6. Detail of the gastric mucosa.

The gastric mucosa is thick and much the same over the whole stomach, being highly convoluted. It is smooth in detail and rather soft to the touch.

Herring and dogfish ingested whole had their skin and scales completely digested off while their underlying tissues remained intact, indicating that the stomach secretes strong digestive enzymes and had not put this food under any considerable muscular stress. Food that had been in the stomach longer was very finely divided. No hard particles of food passed into the intestine.

The pylorus (Figs. 7, 8) was directly on the ventral surface of the

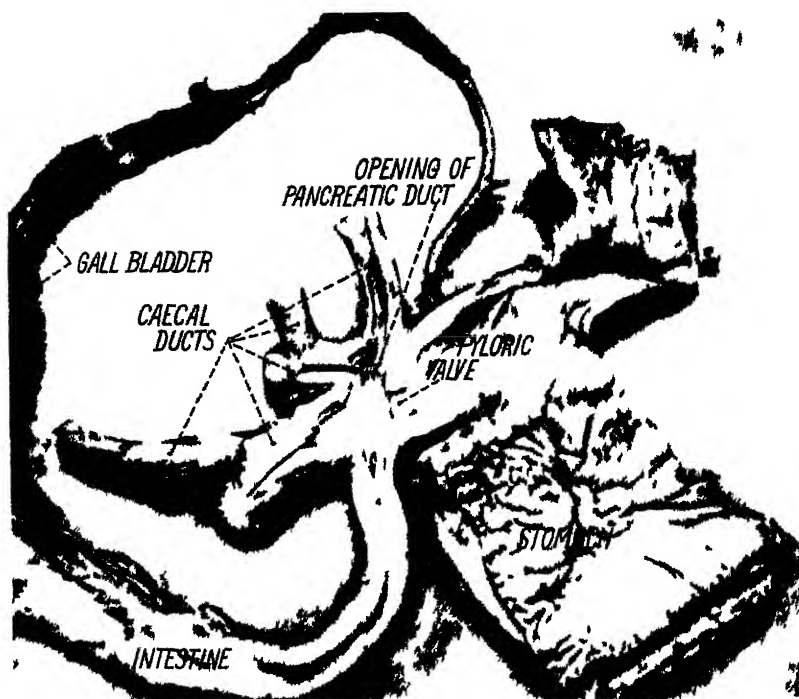


Fig 7. Section of the pylorus and the pyloric caecal ducts; also the gall-bladder, its ducts and the intestinal openings of the bile and pancreatic ducts.

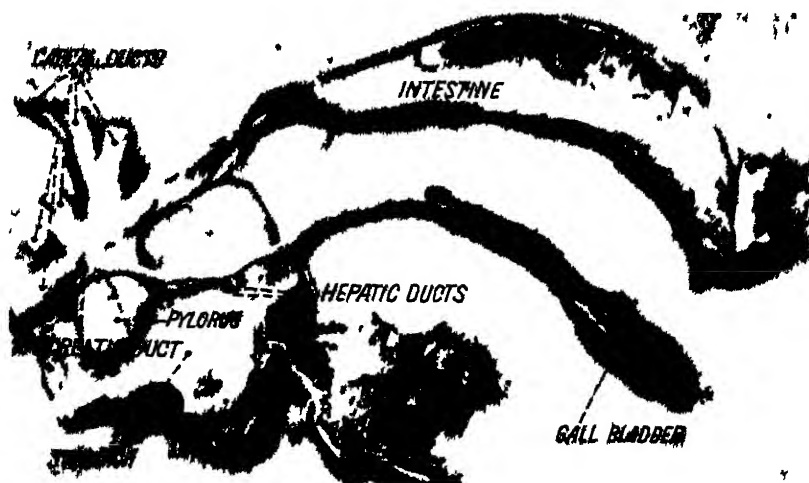


Fig 8 Ventral view of the pylorus and ducts entering it

stomach in the mid-line of our specimens. The pyloric opening was small. By inserting the forefinger it could be followed from within the stomach, first ventrally through an opening protected by a sphincter into



Fig 9 Proximal part of the intestine

a chamber 2 cm. in diameter by 3 cm. in length, in which the mucosa was arranged in longitudinal folds. At the extremity of this pyloric



Fig 10 Ventral view of the body cavity with viscera *in situ*

chamber there was a small opening scarcely 1 cm. in diameter, with firm fibrous walls and a circular valve-like fold of the mucosa. At this point the intestine made almost a right-angled turn to the right and here

were the openings of the enormous pyloric caecal ducts, the bile duct and the pancreatic duct.

The proximal part of the intestine (Figs. 7, 8, 9) is of small diameter with indistinct longitudinal folds within, which, as the size of the lumen increases, break up into an irregular pattern. The spleen lies against this expanded part of the intestine. About 35 cm. from the pylorus the diameter again decreases to 15 mm. and the mucosa is thrown into a series of transverse folds characteristic of the small intestine. They resemble in appearance *valvulae conniventes*. The intestine then forms a series of loops, well shown in figure 10, and terminates with a strong valve at the short, thick, downwardly curved colon, 20 cm. in length.



Fig. 11. Pyloric caeca, showing system of ducts.

The colon is lined with soft, thread-like villi, three or four millimeters in length. The valve between the large and small intestines consisted of a sphincter at the middle of an S-shaped bend and protruding lips on both sides. It was impossible with a syringe to force water from the intestine into the colon or from the colon forward through this ileo-colic valve. The intestine measured 9 1/2 feet from pylorus to vent.

The liver was compact, not elongate, and occupied the ventral and lateral parts of the body cavity between the septum transversum and the pyloric caeca.

Mr. George Lewis of Louisburg gave us the following figures on the weights of swordfish livers compared with the dressed weight of the fish.

The livers are used for their vitamin-containing oil. Two hundred and sixty swordfish, weighing 73,083 lbs (dressed), had livers weighing 1461



Fig. 12 Pyloric caeca, section of the gland

lbs, which is very close to 2 per cent of the dressed weight of the fish.

The smaller the swordfish, the greater its proportional liver weight; thus the fish dissected, which was one of the smallest obtained, had a

total weight of 225 lbs. and a liver of 6 1/2 lbs., or 2.8 per cent of its total weight.

There were five hepatic ducts issuing from the liver to join the cystic duct along 55 mm. of its length. The ductus choledochus passes through the intestinal wall at an acute angle and opens into the intestine from the apex of a papilla close to the pylorus (Figs. 7, 8).

The gall-bladder occupies a position on the right side, between coils of the intestine, far caudad to the liver, and the total length of its duct



Fig. 13. Liver, gall-bladder and pyloric caeca

was lined by longitudinal lamelliform ridges, most pronounced within the gall-bladder and near the terminus of the ductus choledochus.

The pancreatic duct had its opening on the same papilla as the bile duct (Fig. 7), though the two ducts were separate. The pancreatic duct could be distinguished from the bile duct by its thin walls and smooth lining that lacked lamelliform ridges.

By injecting the pancreatic duct it could be followed to the mesentery, where the diffuse and ill-defined pancreas was located.

In the less specialized bony fishes, such as the salmon, the pyloric

caeca (Fig. 4) consist of a few separate finger-like processes, the function of which has been thought to be to increase the surface of the intestinal lining for either absorption or secretion. Mackerels (Fig. 4B) are cited in the literature as having the greatest number of pyloric caeca (up to 191) and as having them not as separate processes, as in the salmon, but formed in a mass bound together by connective tissue and supplied with blood vessels. The swordfish in its pyloric caeca (Fig. 4C) has gone far beyond the stage seen in the mackerels. In a swordfish with a total weight of 225 lbs. the pyloric caeca weighed 10 3/4 lbs. and forms, in fact, an enormous gland, pouring quantities of secretion into the intestine (Figs. 11, 12, 13). In the fishes possessing any considerable number of pyloric caeca two or more caeca unite and have a single intestinal opening. In the swordfish hundreds of caeca open into ducts, which in turn open into the intestine.

AMERICAN MUSEUM NOVITATES

Number 903

Published by
THE AMERICAN MUSEUM OF NATURAL HISTORY
New York City

January 13, 1937

ROTIFERA FROM THE ADIRONDACK REGION OF NEW YORK

BY FRANK J. MYERS

All of the lakes of the southern slope of the Adirondacks are physiographically similar, being of glacial origin and surrounded by hills composed of crystalline rock formations. The biophysical features are virtually the same, and the rotatorian fauna of any one of them is representative of them all.

During a period of several years, numerous collections were made in the following lakes: Caroga Lake, Peck Lake, Van Denburg Pond, Canada Lake, Pine Lake, Stoner Lake, Pleasant Lake, Sacandaga Lake and Piscopo Lake.

As Caroga Lake was the easiest of access, by far the greatest number of collections were made there, and it may be considered the type lake of the series examined.

Caroga Lake, situated about twelve miles northwest of Gloversville, New York, is about three miles in length and one-half mile in width, at the widest part. It is one among the numerous lakes of glacial origin lying on the southern slope of the Adirondack Mountains, all of which are surrounded by rugged, stony shores and the waters are acid, ranging in pH from 6.4 to 7.0.

As is the case in this type of lake, submerged aquatic vegetation is relatively sparse, and is only to be found in abundance in the shallower, protected areas.

The water level of Caroga Lake is maintained by a low dam at the outlet. Between this and where the embankment of state automobile route 10 crosses the southern portion, there is a small, calm area that is protected from wind action and, therefore, from waves of any appreciable size. The water is only several feet deep outside of the narrow channel, and the bottom is carpeted with a vigorous growth of *Sphagnum*, *Nitella* and *Utricularia*. It was here that most of the collections were made.

I am much indebted to Dr. Raymond C. Petrie of Johnstown, for his kind assistance in collecting, and transportation to and from the various lakes, together with extending the facilities of his laboratory which he placed at my disposal.

The following new species are described in his paper:

Notommata parvada

Cephalodella celeris

Notommata stitista

Eothinia carogaensis

Monommata viridis

Dicranophorus minutes

Trichocerca rotundata

Monommata aequalis (Ehreuberg) is re-described and figured.

FAUNAL LIST

The symbols after specific names have the following significance: a, abundant (common at all times); c, common (numerous occasionally); f, few (several here and there); r, less than five; * acid water species.

Adineta vaga (Davis), f

Ascomorpha eucadis Perty, c

Ascomorpha saltans Bartsch, c

Aspella aper Harring, f

Aspella beltista Harring and Myers, f, *

Aspella circinator (Gosse), f

Asplanchna priodonta Gosse, c, limnetic

Asplanchna herrickii de Guerne, c, limnetic

Asplanchnopus dahlgreni Myers, r, *

Asplanchnopus multiceps (Schrank), f

Cephalodella auriculata (Müller), a

Cephalodella celeris new species, f, *

Cephalodella elongata Myers, c, *

Cephalodella eva (Gosse), c

Cephalodella exigua (Gosse), c

Cephalodella forficata (Ehrenberg), f

Cephalodella forficula (Ehrenberg), f

Cephalodella gibba (Ehrenberg), a

Cephalodella gracilis (Ehrenberg), c

Cephalodella hyalina Myers, r, *

Cephalodella intuta Myers, c

Cephalodella inquilina Myers, c, *

Cephalodella megalocephala Glasscott, c

Cephalodella mira Myers, r, *

Cephalodella mucronata Myers, c, *

Cephalodella physalis Myers, f

Cephalodella tantilla Myers, c

Cephalodella tenuior (Gosse), c

Chromogaster ovalis (Bergendal), c

Colurella bicuspidata (Ehrenberg), c

Colurella obtusa (Gosse), a

Colurella sulcata (Stenroos), f

Colurella tessellata (Glasscott), f

Conochilus hippocrepis (Schrank), c

Conochilus unicornis Rousselet, f

- Cyrtontia tuba* (Ehrenberg), f
Dapidia calpidia Myers, c, *
Dicranophorus artamus Harring and Myers, c, *
Dicranophorus alcimus Harring and Myers, r, *
Dicranophorus capucinus Harring and Myers, f
Dicranophorus cernuus Harring and Myers, r, *
Dicranophorus edestes Harring and Myers, f
Dicranophorus epicharis Harring and Myers, c
Dicranophorus hercules Wiszniewski. Piseco Lake, (hygropsammon)
Dicranophorus isotherus Harring and Myers, f, *
Dicranophorus lütkeni (Bergendal), c
Dicranophorus mesotis Harring and Myers, c, *
Dicranophorus minutes, new species, f, *
Dicranophorus proclastes Harring and Myers, f, *
Dicranophorus rostratus (Dixon-Nuttall and Freeman), c
Dicranophorus rostratus corystis Harring and Myers, c
Dicranophorus robustus Harring and Myers, c
Dicranophorus thysanus Harring and Myers, r, *
Dicranophorus uncinatus (Milne). Piseco Lake, r, *
Dissotrocha aculeata (Ehrenberg), c
Dissotrocha macrostyla (Ehrenberg), c
Dorystoma caudata (Bilfinger), f
Dorria dalicarlica Myers. Stoner Lake. Rock moss, near outlet
Ecnentrum felis (Müller), c
Eothinia argus Harring and Myers, f, *
Eothinia carogaensis, new species, f, *
Eothinia elongata (Ehrenberg), f
Eothinia tryphaea Harring and Myers, f, *
Erignatha clastopsis (Gosse), c
Euchlanis alata Voronkov, r
Euchlanis callista Myers, r, *
Euchlanis dilatata Ehrenberg, a
Euchlanis meneta Myers, c
Euchlanis parva Rousselet, c
Euchlanis pellucida Harring, c
Euchlanis triquetra Ehrenberg, c
Floscularia janus (Hudson), c
Floscularia ringens (Linnaeus), c
Gastropus minor (Rousselet), c
Habrotrocha munda (Bryce), f
Keratella cochlearis (Gosse), a
Keratella quadrata (Müller), f
Keratella serrulata (Ehrenberg), f
Lecane acronycha Harring and Myers, f, *
Lecane acus (Harring),¹ f

¹ On account of the growing number of transitions between the genera *Lecane* and *Monostyla*, exhibited in a continually growing number of species, Edmondson (1935) proposed a union of the two genera into the genus *Lecane*. In the same paper he also proposed a union of the genera *Trichocerca* and *Durella* for obvious reasons. The above unions have been adhered to in this paper.

- Lecane brachydactyla* (Stenroos), f, *
Lecane aquila Harring and Myers, f
Lecane arcula Harring, f
Lecane bulla (Gosse), c
Lecane bulla styrae (Harring and Myers), c
Lecane clara Bryce, c
Lecane closteroerca (Schmarda), c
Lecane cornuta (Müller), f
Lecane crenata (Harring), f
Lecane depressa (Bryce), f
Lecane elachis (Harring and Myers), f
Lecane elasma Harring, f
Lecane flexilis (Gosse), c
Lecane furcata (Murray), f
Lecane hamata (Stokes), c
Lecane inermis (Bryce), c
Lecane infula (Harring and Myers), f
Lecane inquieta Myers. Piseco Lake, (hygrosummon)
Lecane intrasinuata (Olofsson), c
Lecane ligona (Dunlop), f *
Lecane ludwigii (Eckstein), f
Lecane luna (Müller), f
Lecane lunaris (Ehrenberg), a
Lecane methoria Harring and Myers, f
Lecane mira (Murray), c
Lecane nana (Murray), f
Lecane pertica Harring and Myers, c, *
Lecane ploensensis (Voight), f
Lecane pygmaea (Daday), f
Lecane pyrha Harring and Myers, f, *
Lecane quadridentata (Ehrenberg), c
Lecane satyrus Harring and Myers, r, *
Lecane signifera (Jennings), f
Lecane stichaea Harring, c
Lecane subulata (Harring and Myers), f
Lecane tenuiseta Harring, f
Lepadella acuminata (Ehrenberg), f
Lepadella cristata (Rousselet), c
Lepadella ovalis (Müller), c
Lepadella patella (Müller), a
Lepadella quinquecostata (Lucks), f
Lepadella triptera (Ehrenberg), c
Lepadella venefica Myers, c
Lindia pallida Harring and Myers, c
Macrochaetus collinsii (Gosse), c
Mikrocodides chlaena (Gosse), c
Mytilina ventralis (Ehrenberg), r
Monommata aequalis (Ehrenberg), c

- Monommata astia* Myers, c
Monommata diaphora Myers, f
Monommata grandis Tassin, c
Monommata longiseta (Müller), a
Monommata maculata Harring and Myers, c
Monommata viridis, new species, c, *
Notholca bostoniensis Rousselet, f
Notholca longispina (Kellicott), c, limnetic
Notommata contorta (Stokes), f
Notommata copeus Ehrenberg, f
Notommata cyrtopus Gosse, c
Notommata doneta Harring and Myers, f, *
Notommata fasciola Myers, r, *
Notommata pachyura Gosse, f
Notommata parvida, new species, c
Notommata peridia Harring and Myers, f, *
Notommata saccigera Ehrenberg, c, *
Notommata silpha (Gosse), c
Notommata stitista, new species, f, *
Notommata thopica Harring and Myers, c
Notommata tripus (Ehrenberg), f
Platyias quadracornis (Ehrenberg), r
Pleurotrocha petromyzon (Ehrenberg), c
Pleurotrocha robusta (Glasecott), f
Pleurotrocha thrua Myers, c, *
Ploesoma formosum Myers, f, *
Ploesoma lenticulare (Herrick), c
Ploesoma triacanthum (Bergendal), c
Ploesoma truncatum (Levander), c
Polyarthra trigla (Ehrenberg), a
Proales decipiens (Ehrenberg), a
Proales doliaris (Rousselet), c
Proales granulatus Myers, f, *
Proales sordida Gosse, c
Proalinopsis gracilis Myers, f
Proalinopsis squamipes Hauer. Stoner Lake, Rock moss near outlet
Pseudoecistes rotifer Stenroos, f
Reticula melandocus (Gosse), f
Rotaria macrura (Ehrenberg), f
Rotaria rotatoria (Pallas), a
Rotaria sordida (Western), c
Rotaria tardigrada (Ehrenberg), f
Rousseletia corniculata Harring, c
Scaridium longicaudum (Müller), c
Squatinella longispinata (Tatam), f
Squatinella mutica (Ehrenberg), f
Squatinella stylata (Milne), r
Stephanoceros millsii (Kellicott), f

Stephanoceros fimbriatus (Goldfuss), r
Streptognatha lepta Harring and Myers, f, *
Synchaeta pectinata Ehrenberg, c
Synchaeta stylata Wierzejski, f
Taphrocampa annulosa Gosse, a
Taphrocampa selenura Gosse, f
Testudinella angulata Myers, c, *
Testudinella dicella Myers, f, *
Testudinella incisa (Ternetz), c
Testudinella parva (Ternetz), c
Testudinella parva bidentata (Ternetz), c
Testudinella patina (Hermann), f
Tetrasiphon hydrocora Ehrenberg, f
Trichocerca bicristata (Gosse), f
Trichocerca brachyura (Gosse), c
Trichocerca cavia (Gosse), a
Trichocerca collaris (Rousselet), a
Trichocerca cylindrica (Imhof), c, limnetic
Trichocerca elongata (Gosse), r
Trichocerca iernis (Gosse), c
Trichocerca lata (Jennings), f
Trichocerca longiseta (Schränk), a
Trichocerca mucosa (Stokes), f
Trichocerca ornata Myers, c, *
Trichocerca plaessa Myers, c, *
Trichocerca porcellus (Gosse), c
Trichocerca rattus (Ehrenberg), c
Trichocerca rosea (Stenroos), a
Trichocerca rotundata, new species, c, *
Trichocerca scipio (Gosse), a
Trichocerca similis Wierzejski, f
Trichocerca sulcata (Jennings), c
Trichocerca tenuior (Gosse), c
Trichocerca tigris (Müller), a
Trichocerca tortuosa Myers, c
Trichotria tetractis (Ehrenberg), a
Trichocerca tetractis caudata (Lucks), c

ORDER MONOGONONTA

Family Notommatidae

Subfamily Notommatinae

Notommata parvida, new species

Figures 1, 4, 7

The body is slender, its greatest width being about one-fourth of the total length. The integument is quite flexible, but the outline is very constant.

There is a transverse skin fold between the head and neck, also one between the

neck and the abdomen. On the dorsal side of the posterior third of the abdomen are two prominent "bosses," one on each side of the median line. The tail is round and has a distinct median notch. The foot has two short joints. The toes are nearly parallel-sided; the base is somewhat enlarged and they are reduced abruptly near the ends, terminating in papillose tips.

The corona extends down on the ventral side about one-fourth the length of the body, and the post-oral portion forms a small chin. The auricles are rather small and are provided with long tufts of locomotor cilia.

The dorsal, lateral and caudal antennae are minute setigerous pits in the normal positions.

The mastax is of normal virgate type. The fulcrum is straight, and tapers toward the posterior end which is enlarged for the attachment of the hyperpharynx. The nearly symmetrical rami appear triangular in ventral view, and the anterior halves are bent at a right angle. Just beyond the anterior angle, the dorsal portion of the right ramus is finely denticulate; the opposing margin of the left ramus is also denticulate, but the teeth are much stouter and more widely spaced than those of the right ramus. The unci are identical in denticulation, each having a robust pre-uncial tooth followed, in turn, by one stout and two somewhat smaller teeth, and a divergent, linear strengthening rib. An extremely thin lamellar plate unites all of these. The manubria are very stout and have a broad central branch and a lamellar, sub-square anterior portion, the depth of which is about one-half of the length of the entire manubrium. A pair of curved rods, attached by their ventral ends to the inner surface of the rami, pass under the manubria and terminate below the dorsal tips of the rami.

The oesophagus is long and slender. The stomach and intestine are not very distinctly separated. The gastric glands are oval and of normal size. The ovary is relatively small and somewhat elongate transversally to the body axis. The bladder is quite small. There are four foot glands, one pair being fairly large, while the other pair are very small.

The retrocerebral sac is large and clear; the subcerebral glands are a little over one-half the length of the sac. The lenticular eyespot is situated at the posterior end of the ganglion.

Total length, 375 μ ; toes, 22 μ .

Notommata parvula was quite common. It is not uncommon in acid water associations in Atlantic County, New Jersey. It is closely related to *Notommata cerberus* (Gosse), from which it differs in the characteristic shape of the toes, the elements of the trophi and by the presence of the lateral "bosses" on the postero-dorsal portion of the abdomen.

Paratype: Cat. No. 877, A. M. N. Hist.

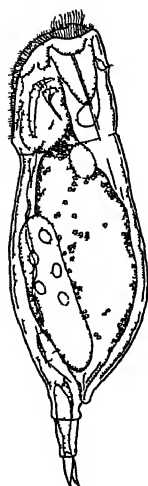
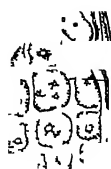
Notommata stitista, new species

Figures 2, 5, 8

The body is short and stout. The integument is transparent and the outline of the body is very constant.

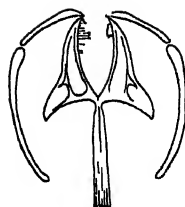
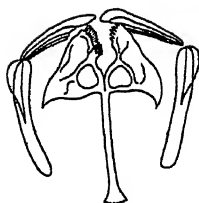
504

RTA



115A

115B



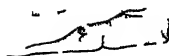
6



7



8



10

- Fig 1 *Notommata parvula*, dorsal view
 Fig 2 *Notommata stitista*, lateral view
 Fig 3 *Eothima carogaensis*, lateral view
 Fig 4 *Notommata parvula*, trophi, ventral view
 Fig 5 *Notommata stitista*, trophi, ventral view
 Fig 6 *Eothima carogaensis*, trophi, ventral view
 Fig 7 *Notommata parvula*, trophi, lateral view
 Fig 8 *Notommata stitista*, trophi, lateral view
 Fig 9 *Eothima carogaensis*, tips of rami
 Fig 10 *Eothima carogaensis* posterior portion of body, lateral view

An inconspicuous fold marks the junction of the neck with the abdomen. The trunk is gibbous both dorsally and ventrally and tapers evenly to the foot, which is composed of two slender joints, the terminal being the longer. The toes are short, undulate and taper to very acute tips.

The antennae are normal and in the usual positions.

The buccal field of the corona is evenly ciliated and continues down the ventral side of the body for about one-fifth of its length forming, posteriorly a slight chin.

The mastax is of the virgate type and the trophi are symmetric and very slender. The fulcrum is long and tapers gradually to the posterior portion which is slightly incurved. The rami are symmetric and triangular, without denticulation on the inner margins. The unci each has three similar teeth; a prominent ventral tooth, followed dorsally by one more slender and a third, nearly rudimentary. The manubria are very slender; below the basal portion there is a prominent lamellar branch which is truncate distally.

The oesophagus is very short. The stomach and intestine are invariably crowded with chlorella and intracellular digestion appears to be in the first stage, or rudimentary. The gastric glands are small and ovate. The ovary is elongate and irregular in outline. The bladder is normal, and the foot glands are long and slender.

The retrocerebral sac is small and pyriform, and no subcerebral glands are present. The eyespot is a small lenticular body, situated at the posterior end of the ganglion.

Total length, 168 μ ; toes, 13 μ .

Notommata stitista was fairly common. It is related to *Notommata venusta* Harring and Myers, from which species it can be distinguished by the very different trophi, the toes, and the presence of chlorella with which the stomach cells of adults are crowded.

Holotype: Cat. No. 873, A. M. N. Hist.

Eothinia carogaensis, new species

Figures 3, 6, 9, 10

The body is cylindric, stout and almost parallel-sided. The integument is very flexible, but the outline is quite constant.

The transverse fold, separating the neck from the abdomen is very distinct. The abdomen is of about the same depth for two-thirds of its length, from whence it tapers somewhat abruptly to the small tail. The foot is short and obscurely wrinkled. The toes are slender and short; from a narrow base they expand abruptly then diminish gradually to acute tips.

The dorsal antenna is a prominent knob-like projection, with a tuft of sensory setae emerging from the tip.

The buccal field of the corona is evenly ciliated and continues down the ventral side of the body for about one-fifth of its length. The apical area is strongly convex and unciliated. The marginal cilia are short, with the exception of two lateral arcs, which are provided with strong locomotor cilia.

The mastax is of a specialized virgate type, representing a superposition of two types (virgate and forcipate) as a secondary adaptation to a different method of feeding. The fulcrum is long and straight; it is formed of two plates joined at the

dorsal edges, so that a cross-section is V-shaped. The distal third of the triangular rami are bent abruptly toward the dorsal side and the bases are expanded into broad decurved alulae. There is a V-shaped opening just above the fulcrum which is followed, on the inner margin of the right ramus, by a fan-shaped comb of long, slender teeth; the inner margin of the left ramus is provided with a similar comb, but it is much smaller than that of the opposing ramus. The unci have but one strong tooth. The manubria are straight rods, slightly incurved in ventral view, and somewhat expanded at the base. The epipharynx is reduced to two very thin triangular plates. Two well-developed salivary glands are present, the gland on the right side of the mastax being the larger.

The oesophagus is long and slender. The gastric glands are small and round. The stomach and intestine are not distinctly marked off. The ovary is normal, and the bladder is very small. The foot glands are long and pyriform.

The ganglion is of medium size. The retrocerebral organ consists of a small clear sac and two subcerebral glands, which are about one-half the length of the sac, including the duct. A round eyespot is situated at the posterior end of the ganglion, while two accessory eyespots are found on the corona near the openings of the ducts of the retrocerebral sac.

Total length, 260 μ ; toes 25 μ .

Eothinia carogaensis was quite rare. It resembles *Eothinia tryphaea* Harring and Myers and *Eothinia poitera* Myers, in the shape of the body. It is closely related to *Eothinia elongata* (Ehrenberg), through the trophi. The general shape of the body, the denticulation of the rami; the corona, one-half of which is prone, together with the wrinkled foot, readily distinguish it from that species.

Type: Cat. No. 878, A. M. N. Hist.

***Monommata viridis*, new species**

Figures 12, 19, 21

The body is cylindric and slender. The integument is very flexible and the outline changes constantly with the contortions of the individual.

The head is not set off from the abdomen by an apparent skin fold or constriction, the entire body being nearly parallel-sided. The stomach ends, anteriorly, in four blind sacs and is pigmented green by the presence of chlorella, digestion being intracellular. The foot is stout and obscurely two-jointed. The toes are extremely long and unequal, the left being about three-fourths the length of the right.

The dorsal antenna is a double papillose projection from the tips of which emerge sensory setae. The lateral antennae are normal.

The mastax is of modified virgate type. The fulcrum is relatively short, curved and tapering. The rami are slender and lyrate; they are bent dorsally near mid-length at an approximate right angle; the dorsal portion has a small tooth on the inner margin near the base. The unci are reduced to excessively thin lamellar plates, the anterior margins of which rest on the lateral edges of the rami; the posterior edges are somewhat thickened, resembling slightly clubbed teeth. The mallei are very small; the central branch of the manubrium is stout and bent abruptly toward the dorsal side; there is a curved digitiform process near mid-length that also curves dorsally.

The retrocerebral sac is round, clear and ductless. A small eyespot is situated at the posterior end of the ganglion.

Total length, 382 μ ; body, 166 μ ; right toe, 216 μ .

Monommata viridis was common. It has also been collected in Atlantic County, New Jersey, where it is found in the littoral region among *Sphagnum* in bodies of acid water. It bears a general resemblance to the other species of the genus, but differs from all of them in the combined characters of the round, clear, ductless retrocerebral sac; the prominent dorsal antenna, the absence of gastric glands and the method of digestion, together with the differences in the trophi.

Paratype: Cat. No. 604, A. M. N. Hist.

Monommata aequalis (Ehrenberg)

Figures 11, 15, 18

Notommata aequalis EHRENBURG, 1832, Abh. Akad. Wiss. Berlin, (for 1831), p. 134; 1838, 'Infusionsthierchen,' p. 432, Pl. 53, fig. 3.

Monommata aequalis EYFERTH, 1878, Einf. Lebensf., p. 84; 1885, p. 109.

Monommata aequalis VOIGT, 1912, 'Susswasserfauna Deutschlands,' pt. 14, p. 104, Fig. 194.

Furcularia aequalis HUDSON AND GOSSE, 1886, 'Rotifers,' II, p. 46, Pl. 104, Fig. 194.

The body of this species is slender, elongate, fusiform and very transparent. The integument is flexible but the outline of the body is quite constant.

The head segment is relatively long and broad. It is separated from the abdomen by several indefinite depressions and elevations. The abdomen falls away gradually to the minute tail. The foot is short, stout and obscurely two-jointed. The toes are long and equal in length.

The dorsal antenna is a small setigerous papilla in the normal position; the lateral antennae are situated on the posterior fourth of the body.

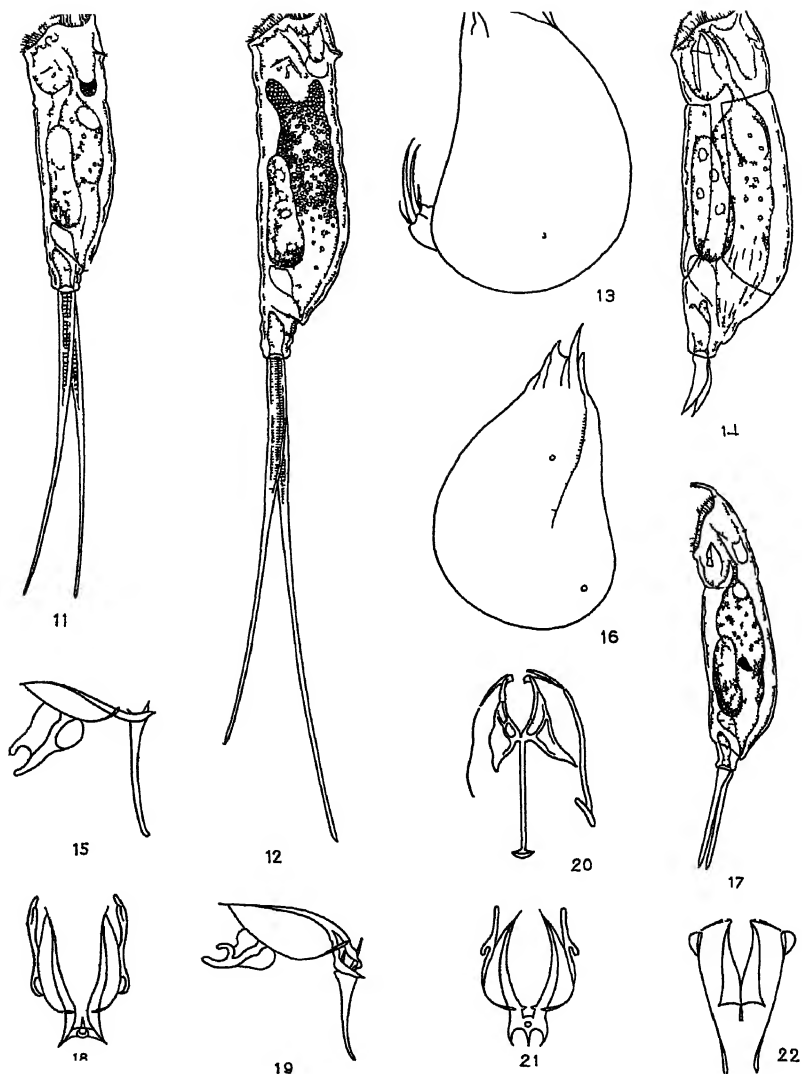
The corona is slightly oblique and consists of a marginal wreath of cilia with lateral auricle-like tufts of longer cilia adapted for locomotion; the apical area is unciliated and the buccal field is evenly clothed with short, close-set cilia.

The mastax, while highly specialized, is of a simple virgate type. The fulcrum is long and slender; its base is expanded and crutch-like. The rami are very slender and lyrate, and lie nearly at a right angle to the fulcrum. The mallei are relatively small; the median branch of the manubrium is stout and nearly straight; the dorsal branch is sub-square and its posterior margin is produced in the form of a projecting lobe; the ventral branch is oval in shape.

The oesophagus is fairly long. The gastric glands are small and oval. The stomach and intestine are not separated by a marked constriction. The ovary is large, and the bladder is normal. The foot glands are stout and pyriform.

The ganglion is long and saccate. The black retrocerebral sac is round and ductless; it encloses the small eyespot, which is situated at the posterior end of the ganglion.

Total length, 227 μ ; length of body, 110 μ ; toes, 117 μ .



- Fig 11 *Monommata aequalis*, lateral view.
 Fig 12 *Monommata viridis*, lateral view
 Fig 13 *Trichocerca rotundata*, lorica, lateral view
 Fig 14 *Cephalodella celeris*, lateral view
 Fig 15 *Monommata aequalis*, trophi, lateral view
 Fig 16 *Trichocerca rotundata*, lorica, dorsal view
 Fig 17 *Dicranophorus minutus*, lateral view
 Fig 18 *Monommata aequalis*, trophi, frontal view
 Fig 19 *Monommata viridis*, trophi, lateral view
 Fig 20 *Trichocerca rotundata*, trophi, ventral view
 Fig 21 *Monommata viridis*, trophi, frontal view
 Fig 22 *Dicranophorus minutus*, trophi, ventral view

Monommata aequalis was common. It seems to be common in weedy ponds almost everywhere, and has probably been overlooked on account of its rather strong superficial resemblance to *Monommata longiseta* (Müller). It is distinguished from that species by the absence of subcerebral glands and the markedly different trophi. The fact of the toes being equal in length does not seem to be of major importance, as the toes of other species of the genus are often nearly equal. It bears a certain resemblance to *Monommata caudata* Myers, the trophi of which species appear to be quite similar, but the presence of longitudinal, converging body striations, the prominent tail and the consistently unequal toes distinguish that from our species.

Cephalodella celeris, new species

Figure 14

The body is elongate and nearly cylindric. The abdomen gradually increases in depth posteriorly, then falls away rather abruptly to the small tail. The longitudinal sulci are distinct and slightly flaring, distally. The foot is small, and the toes are stout and decurved; the basal portion is slightly expanded, then suddenly constricted and again expanded, from whence they diminish gradually to acute tips. The foot glands are stout and pyriform.

The corona is oblique and convex, without protruding lips.

The mastax is of the modified virgate type peculiar to the genus. The manubria are slender, rod-like and curve slightly dorsally. The gastric glands are very large and oval.

The ganglion is long and saccate. Eyespot and retrocerebral sac are absent.

Total length, 135 μ ; toes, 20 μ .

Cephalodella celeris was quite common. It is extremely rapid in all its movements, and resembles several of the eyeless species of the genus superficially; but it can be easily recognized by the peculiarly shaped toes, together with its very rapid method of locomotion.

Paratype: Cat. No. 700, A. M. N. Hist.

Subfamily Trichocercinae

Trichocerca rotundata, new species

Figures 13, 16, 20

The body is short, very stout and round posteriorly. The integument is quite flexible and very transparent. The head sheath is indistinct, and has two prominent anterior mucrones situated on the dorsal side, the right mucro being the longer. There is also a less prominent mucro situated near the ventral side, which is only apparent in fully contracted individuals. A low dorsal ridge arises at the base of the longer dorsal mucro and extends down the body for about two-thirds of its length. The foot is ventrally placed and is removed a distance of at least one-sixth of the entire length of the body from the posterior limit of the lorica. The toes are approximately equal in length and directed forward.

The corona is normal and there is a small digitiform process situated on the apical area.

The antennae are in the usual positions, the two laterals emerging from minute tubules.

The mastax is of the modified virgate type peculiar to the genus, and the trophi are asymmetric. The fulcrum is a long, lamellar plate which is expanded posteriorly. The rami are triangular and the alulae are prominent, the left being more slender than the right. The right uncus is provided with two very slender, bacillar teeth; the left uncus is also provided with two teeth, but they are much stouter than the opposing teeth of the right uncus. The right manubrium is atrophied and bacillar, the left being much more robust, and the distal end is strongly crutched.

The stomach, in adult individuals, is invariably pigmented a bright green, due to the presence of chlorella among the cells of the stomach wall, and digestion is intracellular. There are no gastric glands; the anterior portion of the stomach is produced into two blind sacs crowded with chlorella. The remainder of the anatomy is normal.

Total length, 135 μ ; toes, 35 μ .

Trichocerca rotundata was common among *Sphagnum* wherever found. It is evidently a well-distributed acid water species, and has also been found in Atlantic County, New Jersey; Mount Desert Island, Maine; Vilas County, Wisconsin, and in bodies of water on the Pocono plateau, Pennsylvania.

This species resembles *Trichocerca porcellus* (Gosse), in a number of particulars, and it is possible it may have been mistaken for that species during the past. However, the body is much stouter and rounded posteriorly; the foot is not terminal, but situated on the ventral side, being removed a certain distance from the posterior limit of the lorica; there are no gastric glands and digestion is intracellular. Adult individuals can be recognized at once on account of their bright green color.

Paratype: Cat. No. 446, A. M. N. Hist.

Family Dicranophoridae *Dicranophorus minutes*, new species

Figures 17, 22

The body of this small species is elongate, cylindric and nearly parallel-sided. The integument is very flexible and the outline of the body varies considerably with the state of contraction of the individual.

The head is separated from the abdomen by a well-marked neck fold.

The antennae are very minute and in the normal positions.

The corona is nearly ventral; it is provided with prominent lateral tufts of long locomotor cilia, and the rostrum is large, decurved and rounded anteriorly.

The abdomen tapers rather abruptly to the minute tail. The foot is short, and the toes are very long, parallel-sided and suddenly enlarged, dorsally, near the base.

The mastax is of the forcipate type, and the trophi are very slender. The rami

are triangular and without inner denticulation; the unci each has a single, rod-like tooth. The manubria are very long, slender and slightly expanded at both ends.

A clear retrocerebral sac is attached to the posterior end of the ganglion. There are no eyespots.

Total length, 98 μ ; toes, 32 μ .

Dicranophorus minutes was quite common. It is widely distributed among wet marginal and submerged *Sphagnum* in acid ponds and ditches, but is never numerous. It is readily distinguished from the other small species of the genus by the absence of eyespots, the delicate trophi and the long, straight toes expanded at the base.

Paratype: Cat. No. 872, A. M. N. Hist.

REMARKS ON DISTRIBUTION

Individual stragglers belonging to the alkaline water fauna are occasionally found in acid water associations and vice versa. Rotifers, transferred from one association to the other, do not seem to be affected by the change in hydrogen-ion concentration, nor are the eggs of duration, which hatch out producing amictic females. The resulting eggs of these parthenogenetic females do not hatch, however, and the line of succession is thereby definitely ended.

The following genera may be designated as typical of alkaline water: *Brachionus*, *Eosphora*, *Notholca*, *Sinantharina* and *Laciniularia*. There are also numerous species, within certain genera, that belong definitely to either the acid or alkaline fauna, and the presence or absence of these is a reliable index as to the hardness or softness of a certain body of water.

During a period of over twenty years collecting among the various bodies of acid water in Atlantic County, New Jersey, only four stragglers of the genus *Brachionus* have been recorded: *Brachionus capsuliflorus* Pallas, three times, and *Platyias* (*Brachionus*) *patulus* (Müller), once. No specimens of any other of the above genera have been recorded. Many species of *Cephalodella*, *Lepadella*, *Lecane* and *Trichocerca* are acid water rotifers. *Asplanchnopus multiceps* (Schränk) is an alkaline water rotifer, while its relative *Asplanchnopus dahlgreni* Myers is an acid water species. *Eosphora thoa* Harring and Myers, an acid water rotifer, is not uncommon in Atlantic County, while its near relative, *Eosphora anthadis* Harring and Myers, an alkaline water species, has never been recorded from there.

Carnegie Lake, Princeton, New Jersey, a body of alkaline water, is only about fifty miles from the Pine-barrens of New Jersey, the waters of which are all acid. There are no physical barriers intervening, the

country being quite flat. *Brachionus* is the predominating genus in Carnegie Lake, virtually at all times. *Asplanchna* is also abundant. No acid water rotifers occur in that lake and no alkaline rotifers occur in the Pine-barrens.

Just north of Fonda, New York, there is a series of large permanent pools, several of which are over an acre in area. They lie between state automobile route 5 and the embankment of the New York Central Railroad. Several of these pools are directly connected with the Mohawk River by underpasses, and the waters are all alkaline. The predominating species are *Brachionus*, *Keratella* and *Notholca*. Caroga Creek, the outlet of Caroga Lake, empties into the Mohawk River not far from these pools, and it is reasonable to assume that a certain portion of the waters mingle. Yet, no acid water rotifers have been found in the pools, and, as seen from the faunal list, no alkaline water rotifers were found in Caroga Lake.

During the course of time, the majority of rotifers, known as trans-cursion or cosmopolitan species, have become tolerant to reasonable changes in hydrogen-ion. Such rotifers are distributed throughout the world wherever conditions of existence permit, and are found in either acid or alkaline water associations. The great majority of rotifers belong to this fauna.

Proales rheinardti (Ehrenberg) is found among moss in the clearest of mountain springs; it is also found among *Fucus* in the sheltered parts of bays and inlets of the ocean, the waters of which are highly alkaline. If, as is supposed, the fresh water is the original home of the rotifers, the element in which the group originated, then it is reasonable to suppose that the brackish and salt water species have emigrated from fresh water and, in doing so, have become tolerant of the change in hydrogen-ion and also specific gravity. A number of rotifers have become adapted to this change by structural modifications. *Encentrum villosum* Harring and Myers, a salt-water species, is found among algae in salt pools near the outlet of Great Egg Harbor River, New Jersey. It is clearly derived from its close relative *Encentrum felis* (Müller), which is found among algae in the fresh water of the same river about twenty miles from the outlet. This seems to be a case of immigration. *Proales rheinardti* appears to have undergone the change without any anatomical modifications, as far as can be seen.

If such changes in distribution can be made during the course of time, it is reasonable to suppose the acid water rotifers are gradually becoming tolerant of alkaline water associations, which are far more

abundant throughout the world, and will eventually become transcurcion species.

LITERATURE CITED

- EDMONDSON, W. T. 1935. 'Some Rotatoria from Arizona.' Trans. Amer. Micr. Soc., LIV, pp. 304-305.

CORRECTIONS

'Psammobiotic Rotifers of Lenape and Union Lakes, New Jersey.' Amer. Mus. Novit., No. 830, March, 1936. The genus *Dicranella* being preoccupied (*Crustacea: Ostracoda*, E. Ulrich. 1894), genus *Pedipartia* is hereby substituted.

On pp. 9 and 20, for *Aspelta egregium*, read *Aspelta egregia*.

On p. 14, for *Asplanchna harricki*, read *Asplanchna herrickii*.

AMERICAN MUSEUM NOVITATES

Number 904

Published by
THE AMERICAN MUSEUM OF NATURAL HISTORY January. 13, 1937
New York City

NOTES ON THE GENUS *SERICORNIS* GOULD

By ERNST MAYR

*Sericornis*¹ is one of the most difficult genera of the Australian region. I have tried in an earlier paper (1930, Ornith. Monatsber., pp. 176-178) to settle some of the problems of nomenclature of this genus, but many questions remained to be answered. The splendid series collected by the Archbold-Rand New Guinea Expedition of 1933, together with the material of the Rothschild collection, have permitted a new survey of the genus, which has clarified some of the problems. Dr. Stresemann has been so kind as to send me the material of the Berlin Museum, including several types, for which I am deeply obliged to him.

One of the principal aims of the present review is to outline a more natural classification of this genus than that proposed by Mathews, the last reviewer. He recognizes the following species (1930, 'Syst. Avium Australasianarum,' pp. 611-618):

- (1) *Neosericornis citreogularis* (Gould) (p. 611)
- (2) *Sericornis arfakianus* Salvadori (p. 611)
- (3) " *olivaceus* Salvadori (p. 612)
- (4) " *perspicillatus* Salvadori (p. 612)
- (5) " *papuensis* (DeVis) (p. 612)
- (6) " *nigrorufa* Salvadori (p. 613)
- (7) " *beccarii* Salvadori (p. 613)
- (8) " *bürgersi* Stresemann (p. 613)
- (9) " *magnirostris* (Gould) (p. 613)
- (10) " *keri* Mathews (p. 614)
- (11) " *frontalis* (Vigors and Horsfield) (p. 614)
- (12) " *laevigaster* Gould (p. 614)
- (13) " *minimus* Gould (p. 615)
- (14) " *maculatus* Gould (p. 615)
- (15) " *tyrrannulus* DeVis (p. 617)
- (16) *Tasmanornis humilis* (Gould) (p. 617)

To these are to be added one species omitted by Mathews,

- (17) *Sericornis aruensis* Ogilvie-Grant

and several species included by Mathews in other genera:

- (18) *Gerygone? rufescens* Salvadori (p. 458)
- (19) *Arfakornis arfakiana* (Salvadori) (p. 465)
- (20) *Aethomyias spilodera* (Gray) (p. 478)

¹ *Sericornis* means silk bird. *Ornis* has both masculine and feminine gender, but according to several Greek dictionaries, consulted by me, masculine is the preferred gender. For this reason I shall use *Sericornis* exclusively in the masculine gender.

This arrangement not only fails to group the related species together, but it also lists as full species several forms which are really nothing but geographical representatives. One of the species (*nigrorufa*, No. 6) belongs to the genus *Crateroscelis*, where I have placed it already in an earlier paper (1931, Mitt. Zool. Mus. Berlin, XVII, p. 688). Another species (*tyrannulus*, No. 15) apparently also belongs to another genus. Neither the description nor the locality speaks for its retention in the genus *Sericornis*. The type locality, Charleville, lies in the dry interior of Queensland with less than 20 inches of rain per year, an area not inhabited by any member of this genus. Campbell (1935, Emu, XXXIV, pp. 267-273) has discussed several other species which he considers related to *Sericornis*, though generically distinct. Of these, *Acanthornis magnus* might well be included in the genus *Sericornis*. It agrees well with *S. frontalis* and *citreogularis* in its general type of coloration and is also similar in its morphological features, except for the slender, curved bill. If recognized, *Acanthornis* would be the only endemic avian genus of Tasmania.

The morphological characters of the genus *Sericornis* are ill-defined as is the case with most genera of passerine birds. They have been discussed by Meise in his review of the genus *Gerygone* (1931, Novit. Zool., XXXVI, pp. 318-319). The most remarkable fact is that the genus is usually put in the Sylviidae, but that some of its species were described as Muscicapidae (*arfakianus*, *rufescens*, *spilodera*), and that another (*nigrorufa*) is now included in the genus *Crateroscelis* of the Timaliidae. This illustrates the impossibility of giving a clearly cut generic definition of this genus which, in its characters, ranges all the way from the "Muscicapidae" through the "Sylviidae" to the "Timaliidae." On the other hand nothing would be gained if we should try to break up the assemblage of species which is now included in this genus.

As the result of my studies, I propose the following arrangement of the species of this genus:

- I.—*citreogularis* (1).¹
- II.—a, *maculatus* (14); b, *humilis* (16); c, *frontalis* (11), including *laevigaster* (12); d, *beccarii* (7), including *minimus* (13).
- III.—*spilodera* (20), including *aruensis* (17).
- IV.—a, *magnirostris* (9), including *keri* (10); b, *nouhuysi* (2).
- V.—*perspicillatus* (4).
- VI.—*rufescens* (18).
- VII.—*papuensis* (5), including *bürgersi* (8).
- VIII.—*arfakianus* (19), including *olivaceus* (3).

¹ Figures in parentheses refer to the figures of Mathews' sequence (see p. 1).

In Australia the various species that may occur at one locality are always so different that they can be identified quite easily. Several New Guinea species, however, are very similar to each other. To facilitate the identification of such birds, I have prepared the following key which is partly based on the key published by Stresemann in 1923 (Arch. f. Naturgesch., LXXXIX, Heft 8, pp. 13-14).

KEY TO THE PAPUAN SPECIES OF *Sericornis*

- 1.—A distinct white spot on either side of the forehead.....*beccarii-cyclopus*.
Not so.....2.
- 2.—No distinct black subterminal bar on tail.....3.
A distinct black subterminal bar on tail.....5.
- 3.—Entire lower mandible yellowish horn-colored.....*spilodera*.
Lower mandible partly or totally brownish or black.....4.
- 4.—Larger (wing usually above 60), no whitish or pale gray tips on wing-coverts.....*nouhuysi*.
Smaller (wing 54-62), whitish or pale gray tips on wing-coverts..*virgatus*-group.
- 5.—Contains four species: *papuensis*, *rufescens*, *perspicillatus*, and *arfakianus*, which cannot safely be separated by key characters.
perspicillatus: sides of face orange-ochre, sharply contrasting with crown; crown and nape grayish green, back and rump brownish olive.
rufescens: under parts buffy; sides of head dull pale ochraceous; upper parts dull brownish olive; black tail-bar well developed; Arfak Mts. only.
papuensis: Very variable; bright colors; tail very brown, with broad black bar; large size (wing 53-61); sides of face mostly washed with brownish.
arfakianus: dull green above, greenish white below; sides of face grayish green; tail-bar indistinct; small (wing 48-56).

The habitat of the various species of this genus is not always the same. Of the six species that occur in New Guinea (omitting the little known *rufescens*), never more than three can be found at any one locality, because their vertical ranges are not identical. While in Australia all of the species occur in the lowlands, only one of the New Guinea species (*spilodera*) does so regularly. One other species (*beccarii*) has been found in the lowlands on the Aru Islands and in South New Guinea, but it is not known to descend below 400 m. in the rest of its New Guinea range. The data at hand seem to indicate that the vertical ranges of the various races of *beccarii* are rather different, being lower in the Arfak and Sepik Mts. and higher in the Weyland Mts. and Mamberano Mts. (Doormanpaad.) The same phenomenon can be observed in *perspicillatus* and *nouhuysi*; both of which have in southeast New Guinea a higher altitudinal distribution than in north New Guinea (Saruwaged Mts.).

Two of the species are definitely birds of the lower mountain forest,

arfakianus occurring between 800 m. and 1600 m. and *perspicillatus* a little higher, between 1400 m. and 2400 m. The remaining two species occur right up to the upper tree limit, but *nouhuysi* (1500–3700 m.) descends lower than *papuensis* (2000–3700 m.).

All the species are similar in their habits. They are usually found in the undergrowth or on small trees in the heavy forest. *S. spilodera* also ventures out into second growth and into the higher parts of trees, while *S. nouhuysi*, on the other hand, particularly likes the low plant growth of the forest floor.

Further details on the life history of the Australian species are given in Campbell's monographic review 'The genus *Sericornis* in Australia, with notes on four monotypic genera' (1935, Emu, XXXIV, pp. 249–274).

Sericornis citreogularis Gould

This is a well-defined species, but no reason exists to separate it generically. *S. frontalis* is probably the nearest relative of this species which lives in the semi-tropical woodlands of eastern Australia.

Sericornis citreogularis citreogularis Gould

Sericornis citreogularis GOULD, 1838, 'Synopsis Birds Austr.', pt. 4, Pl. LVIII, fig. 4.—New South Wales.

Sericornis lathami auctorum.—This name was based on the "Watling Drawing No. 180," which, according to Mathews, is indeterminable. I have not been able to investigate this matter.

Sericornis lathami intermedia MATHEWS, 1912 (Jan. 31st), Nov. Zool., xviii, (1911), p. 354.—Blackall Range, south Queensland. [Type (♀) examined.]

RANGE.—Eastern Victoria, eastern New South Wales, and southeast Queensland, northward about to the 25° S. According to Campbell no actual records exist from south of Bulli (N.S.W.) and from north of Moreton Bay. There appears to be a decided break between the range of this subspecies and that of *cairnsi* which seems to be restricted to the wet belt in the Cairns district.

Sericornis citreogularis cairnsi Mathews

Sericornis lathami cairnsi MATHEWS, 1912, Nov. Zool., xviii (1911), p. 354. —Kuranda (near Cairns), north Queensland. [Type (♀) examined.]

CHARACTERS.—Weak form. Black of ear-coverts, lores and forehead deeper and more extensive; crown darker and less olivaceous; back darker and duller olivaceous, lacking the warmer brownish tone of typical birds; sides of breast and flanks average more cinnamon, less rufous, and the throat a deeper yellow.

RANGE.—Apparently restricted to the wet Cairns district of north Queensland. The species seems to be absent from Cape York.

		WING	TAIL	TARSUS	WING
<i>citreogularis</i>	♂	66-71 (68.4)	54-57 (55.5)	28	♀ 64-70 (66.9)
<i>cairnsi</i>	♂	67-71 (68.6)	53-54 (53.7)	27	♀ 63, 64

MATERIAL EXAMINED.—*S. c. citreogularis*: Gosford and Ourimbah, N.S.W., 3 ♂; Bulli Pass., N.S.W., 1 ♀; Blue Mts., N.S.W., 1 ♀; Tweed River, N.S.W., 2 ♂; Richmond River, 2 ♀; Bunya Mts., south Queensland, 1 ♀; Blackall Range, south Queensland, 1 ♂, 1 ♀.—*S. c. cairnsi*: Tolga, north Queensland, 3 ♂; Kuranda and Barron River, 2 ♂.

Superspecies *Sericornis frontalis*

This superspecies comprises a number of forms which are still insufficiently understood. Although I have examined a great deal of material, I have been unable to clarify the specific status (and the value of the many described subspecies) of some of the "species" of this group. There are three reasons for this. One is the great individual variation in this group. I have seen, in some of the populations, specimens with tailbands and without such, specimens with spots on the throat and without such, and whatever other differences are supposed to distinguish the various species and subspecies. The second reason is the decided geographical variation in these species. Hardly two series from any two localities are quite alike. And the third reason is the manner of distribution, which seems to be determined largely by rainfall and vegetation. We thus find different subspecies in the mountains than in the lowlands, and on the coast different ones from those inland. It has therefore been possible only to make a preliminary survey and grouping of the related species and forms. A more detailed revision will be undertaken at a later occasion.

I recognize four species in the superspecies *frontalis*: *maculatus*, *humilis*, *frontalis*, and *beccarii*.

Sericornis maculatus Gould

RANGE.—West, southwest and south Australia and off lying islands, such as Dick Hartog Islands and Kangaroo Island.

This "species" apparently intergrades with *frontalis* in the region of Cape Jervis and Mt. Lofty.

Sericornis humilis Gould

RANGE.—Tasmania and islands of Bass Straits.

This "species" is clearly a representative of *frontalis*, with which it is connected by the various races on the islands of Bass Straits and south-

ern Victoria. In fact, several of the races of *humilis* were originally described as subspecies of *frontalis*. I fail to understand how Campbell can say (1935, Emu, p. 267): "They cannot in any way be considered as links between the two."

Sericornis frontalis Vigors and Horsfield

RANGE.—Southeastern South Australia, Victoria, New South Wales and Queensland north to the Herberton district. Apparently never occurring west of the 25" Isohyograph, although of spotty distribution even in regions of sufficient rainfall, particularly in the northern part of its range.

Shows considerable geographical variation in the various parts of its range. The throat shows much spotting in the Mt. Lofty region, Southern Australia (*rosinae* Mathews), and in southern Victoria, less in New South Wales and almost none in Queensland (*laevigaster* and *herbertoni*). The tail shows no sign of a black bar in the Mt. Lofty region nor in most specimens from Victoria. There is a faint indication of a black bar in most typical *frontalis* (Sydney, N.S.W.), which becomes more pronounced as we go north in the following series of forms: *tweedi* Mathews (Richmond and Tweed Rivers), *laevigaster* (southern Queensland, Blackall Range, Brisbane district, and upper Dawson River) and *herbertoni* (Herberton plateau, north Queensland). The white superciliary line is sometimes continued toward the nape (*herbertoni*), or it stops immediately back of the eye; the ear-coverts in the adult males are either blackish as the lores (*laevigaster* and *herbertoni*) or grayish brown.

It is quite impossible to regard *laevigaster* as a distinct species from *frontalis*. They are perfectly connected by intermediates; in fact, *laevigaster* itself is nothing but an intermediate between *frontalis* and *herbertoni*.

I do not believe that *Sericornis tyrannulus* DeVis is a synonym of *S. f. laevigaster*. The description does not fit the young of *laevigaster*, and the type locality (Charleville) is in a dry belt, where no members of the genus *Sericornis* occur (but see Campbell, 1935, Emu, p. 256).

I have not seen enough material from southern New South Wales, Victoria and eastern South Australia to make any definite statements about the distribution, validity and characters of the races: *frontalis*, *longirostris*, *harterti*, *rosinae* and *wyldei*. I have contented myself with a short characterization of the more northern forms: *tweedi*, *laevigaster* and *herbertoni*.

Sericornis frontalis tweedi Mathews

Sericornis laevigaster tweedi MATHEWS, 1922, 'Birds Australia,' X, p. 16.—Tweed River, northeastern New South Wales.

CHARACTERS.—Very similar to *S. f. frontalis* Vigors and Horsfield, but spotting on throat reduced or absent; with a definite black bar across the tail, which is either lacking or barely indicated in *frontalis*; general coloration of upper and under parts and pattern of the face variable and apparently as in *frontalis*.

RANGE.—Northeastern New South Wales from the Richmond River northward, and southeastern Queensland north to the Blackall Range, where it intergrades with *laevigaster*.

I have not examined enough material to work out the exact range of this subspecies as compared with typical *frontalis*. There is, however, no doubt that the blackish tail-band is more conspicuous in birds from northeastern New South Wales than in those from Sydney and farther south.

Sericornis frontalis laevigaster Gould

Sericornis laevigaster GOULD, 1847, Proc. Zool. Soc. London, p. 3.—Near Expedition Range, head of Dawson River, at about 149° E. and 25° S., 480 mi. from Brisbane (according to Campbell, *loc. cit.*, p. 255).

The type in the Acad. of Natural Sciences of Philadelphia is the only specimen of this subspecies examined by me. It has the black bar across the tail and the whitish tips very well developed, almost as well as the specimens of *herbertoni*. A female from the Blackall Range (E. Ashby coll.), which has always been listed as *laevigaster*, has the black-brown tail-bar not as wide, and only narrow whitish margins on the outermost tail-feathers. This specimen is clearly intermediate between "*tweedi* Mathews" and *laevigaster*.

To Campbell we owe the information that the type of *laevigaster* was collected in the eastern rain belt, less than 200 miles from the coast, and not in "the interior of Australia near the Gulf of Carpenteria," as stated by Gould, Mathews and other Australian authors.

Sericornis frontalis herbertoni Mathews

Sericornis parvula herbertoni MATHEWS, 1912, Nov. Zool., XVIII (1911), p. 355.—Herberton, north Queensland. [Type examined.]

CHARACTERS.—Very pronounced race. The four outer tail-feathers are broadly tipped with white; the subterminal black bar is very broad and present in all the tail-feathers, except the central pair; the superciliary line is broad, clearly defined and continued beyond the eye to the nape; the upper parts are lighter than in *frontalis* and less brownish, more olivaceous-cinnamon on back, rump and tail; the ear-coverts are very dark; the upper throat with no or few spots.

The female differs from the male, as usual, by the brownish instead of black

lores and by the paler yellow of the under parts; the only female examined (the type) also differs from the only male examined (from Calluingal, central Queensland) by a slightly more brownish coloration of crown, back and tail.

	WING	TAIL	CULMEN	TARSUS
♂ ad.	59	50	15	21
♀ (type)	57 5	48 5	15	19

RANGE.—Apparently restricted to the Herberton district in northern Queensland; recorded from Herberton, Kiriama and Calluingal.

Sericornis beccarii Salvadori

RANGE.—Tropical lowlands of the Cape York Peninsula (Queensland), the Aru Islands and south New Guinea, and also upper tropical forest in the mountains of north central New Guinea.

Although this species is obviously a geographical representative of *Sericornis frontalis* of Eastern Australia, it seems preferable to keep it as a distinct species, since it is characterized in all its forms by a specific and rather constant color pattern. The tail is without a black bar; there are conspicuous white supraloral spots, which are not joined with the short superciliary; the feathers on the lower circumference of the eye are white; the upper wing-coverts and the alula are blackish with broad white tips.

Within the species we can distinguish three representative groups of subspecies, which I am naming after the oldest subspecies of each group: *beccarii*, *cyclopus* and *virgatus*-groups.

beccarii-group

To this group I refer the forms that occur in the tropical lowlands of the Cape York Peninsula, Aru Islands and south New Guinea. Characterized (except *dubius*) by the small amount of olivaceous wash underneath, by small size, by the distinct whitish throat, by the darkness of primary- and upper wing-coverts, and in the males by the large size of the white frontal spots and the large extent of the black marks on forehead and lores.

Sericornis beccarii minimus Gould

Sericornis minimus GOULD, 1875 (Dec. 1st), 'Birds New Guinea,' pt. I. Cape York, North Queensland.

Sericornis brunneopygius MASTERS, 1876 (Feb.), Proc. Linn. Soc. New South Wales, I, p. 53.—Cape York.

Sericornis minimus yorki MATHUEWS, 1922, 'Birds Australia,' X, p. 19.—Piaru Scrubs, Cape York [type examined].

ADULT MALE.—Pale form. Crown cinnamonaceous, lores dark, but not quite

black; blackish line surrounding the white supraloral spots narrow; throat clear white or with little spotting; belly yellow, sides of breast and flanks with inconspicuous pale grayish-brown streaks.

Wing, ♂ 57, 57.5, 59, 59, 59.5, ♀ 54, 54, 55; tail, ♂ 40, 42, 43, 44, 44, ♀ 39.5, 40, 40; culmen, ♂ 15.2–16.0, ♀ 14.2–15.1; tarsus, ♂ 19–21, ♀ 18.5–19.

RANGE.—Cape York, northern part.

Most specimens of this species have the back much more greenish than the crown; the type, however, belongs to a phase with a more brownish back. Nestlings have a soft, downy plumage, but are otherwise very similar to adults. They do not have any rufous wash on the under parts, and the pattern on wing and head is approximately as in the adults. Back and rump are slightly more rufous brown.

Sericornis beccarii dubius, new subspecies

TYPE.—No. 450834, Amer. Mus. Nat. Hist. (Rothschild collection); ♂ ad.; "Cape York," N. Queensland; July 9, 1898.—A. S. Meek.

Adult male similar to *S. b. minimus*, but more brownish throughout, and with the facial pattern less defined. On both sides of the forehead a buffy-white spot; lower eyelid and short superciliary stripe buffy; rest of face cinnamonaceous; upper throat whitish with a few brownish spots; lower throat and breast pale ochraceous; abdomen whitish with a yellowish-buff wash; flanks and under tail-coverts darker, grayish ochraceous; upper parts similar to that of the brownish phase of *minimus*, but still more brownish on back; wing brownish, medium and greater upper wing-coverts, alula and primary coverts blackish brown, wing-coverts with narrow whitish tips.

Female similar to male but still more brownish. Upper throat, frontal spot, lower eyelid and superciliary washed with buffy cinnamonome.

Wing, 2♂ 60, 60, ♀ 55; tail, 2♂ 43, 44, ♀ 40; tarsus, 2♂ 21, 21, ♀ 20.

Two specimens from the Watson River in Northern Queensland have the black pattern on the forehead much reduced and the white washed with buffy. On the under parts, also, they have a slight buffy wash on breast and flanks. These specimens probably lead over to *dubius*. All three specimens of *dubius* are perfectly adult, and since nestlings of *minimus* already show all the typical characters of that subspecies, it cannot be argued that *dubius* is the young of *minimus*. The typical series was collected by Meek in July, 1898, all three specimens probably in the same place, but the label does not indicate in what section of the Cape York Peninsula. The extensive material in the Mathews collection from the northern tip of Cape York (8 ♂, 3 ♀, 3 (?) from Cable Station, 3 ♂, 3 ♀, 1 (?) from Utingu, and 3 ♂, 1 ♀ from Piara Scrubs) are all very similar and agree with the plate of Gould's *minimus*. The description of *brunneopygius* also clearly refers to the bird from the north tip of Cape York. *S. b. dubius* is much too similar to *minimus*

to be regarded anything but a subspecies. The existence of somewhat intermediate specimens from Watson River indicates that the type series of *dubius* may have been collected in the southern portion of Cape York Peninsula. The remarks of D. F. Thomson (1935, 'Birds of Cape York Peninsula,' p. 61) confirm this conclusion. Meek collected his specimens probably somewhere near Princess Charlotte Bay.

***Sericornis beccarii beccarii* Salvadori**

Sericornis beccarii SALVADORI, 1874, Ann. Mus. Civ. Genova, VI, p. 79.—Wokan, Aru Islands.

ADULT MALE.—Similar to *minimus* Gould, but darker throughout; crown a darker brown, many feathers with blackish edges; back variable as in *minimus*, sometimes more brownish, sometimes more olivaceous, but averaging distinctly darker; lores black; blackish line surrounding the white supraloral spots broad; throat white, with the black spots usually quite pronounced; belly yellowish; breast and flanks with conspicuous grayish-olivaceous streaks; wings and tail of a warmer, more rufous brown; white tips on upper wing-coverts smaller.

Wing, ♂ 59, 59, 60.5, ♀ 52.5, 53; tail, ♂ 42, 43, 43.5, ♀ 38, 39; tarsus, ♂ 20–21, ♀ 18.

RANGE.—Aru Islands.

***Sericornis beccarii randi*, new subspecies**

TYPE.—No. 422041, Amer. Mus. Nat. Hist.; sex ? [= ♂ ad.]; Wuroi, Oriomo River, Western Division of Papua; Jan. 25, 1936; R. Archbold and A. Rand.

ADULT MALE.—Similar to *beccarii*, but more greenish; crown dark hair-brown, most feathers with blackish edges; back greenish olivaceous; lores black; blackish line surrounding the white supraloral spots broad; ear-coverts olivaceous brown; upper throat white with indistinct black longitudinal streaks; breast and belly pale yellow; breast with conspicuous gray streaks; flanks olivaceous; under tail-coverts yellowish, not rust-colored as in *beccarii*; thighs blackish brown; tail cinnamomeous brown; edges of wing-feathers olivaceous; outer upper wing-coverts deep black with broad white tips. Differs from *minimus* mainly by the coloration of head, throat and breast, and from *beccarii* by that of wing, tail and under tail-coverts.

RANGE.—Only known from the type locality in the lowlands of South New Guinea.

	WING	TAIL	CULMEN	TARSUS
2 ♂	57.5, 58.5	42, 45	14, 16	20, 20
1 ♀	55	41	15.5	18

cyclopum-group

The three forms *minimus*, *beccarii* and *randi* are rather closely related as is shown by their similarity of coloration and by their distribution in tropical lowlands. In western New Guinea, however, we find

some races of this species which live in the hills at altitudes of about 600 m. to 1400 m., and which have a somewhat different type of coloration, particularly on the under parts, which are very similar in the three following forms. The differences between them relate mostly to the color of the face in which respect *cyclopum* is intermediate between *weylandi* and *wondiwoi*.

Sericornis beccarii cyclopum Hartert

Sericornis magnirostris cyclopum HARTERT, 1930, Nov. Zool., XXXVI, p. 83.—Cyclop Mountains.

ADULT MALE.—A dark subspecies, with the brown crown contrasting with the dull grayish-olive back; rump with a rufous tinge; white supraloral spots and eye spots small; blackish line surrounding the white supraloral spots narrow; lores brownish black; ear-coverts cinnamomeous; throat white, mottled with grayish; a broad gray-green breast-band, separating the white throat from the pale greenish-yellow belly; flanks grayish olivaceous; thighs cinnamon; tail-feathers rufous brown; edges of wing-feathers olivaceous with a brown wash; alula and outer upper wing-coverts brownish black with narrow white tips.

Wing, ♂ 58, 60.5, ♀ 54.5; tail, ♂ 40, 42, ♀ 38.5; culmen, 16; tarsus, 19–21.

RANGE.—Cyclop Mts., northern New Guinea.

Sericornis beccarii weylandi, new subspecies

TYPE.—No. 301998, Amer. Mus. Nat. Hist.; ♂ ad.; Mt. Kunupi, Weyland Mts.; Sept. 23, 1931; Georg Stein.

ADULT MALE.—Similar to *S. b. cyclopum*, but coloration of face different and more rufous throughout. The white supraloral spots are larger, the black line surrounding them is broader, the lores are apparently more blackish; the back, and the inner and outer edges of the wing-feathers are more rufous; the flanks and under tail-coverts are washed with rufous; the upper wing-coverts are more clearly black.

Differs from *randi* by the paler greenish-yellow coloration of the belly, by the presence of a distinct grayish band across the breast, which is dissolved into longitudinal streaks in *randi*, and by the presence of rufous colors on the tail, the under tail-coverts, the inner and outer edges of the wing-feathers and on the rump and lower back; resembles *randi* in the coloration of the face. The color of the feet in *weylandi* is apparently also much darker than in *randi*, where it is pinkish white.

Wing, ♂ 63, 63, 63, 64, ♀ 58.5, 59, 60; tail, ♂ 42, 43, 45, 46, ♀ 41, 41.5, 44.

RANGE.—Weyland Mts. and also probably mountains on the upper Mamberano (see Hartert, 1932, Nova Guinea, XV, p. 461).

Sericornis beccarii wondiwoi, new subspecies

TYPE.—No. 293861, Amer. Mus. Nat. Hist.; ♂ ad.; Wondiwoi Mts., northwest New Guinea (Wandammen district); July 9, 1928; Ernst Mayr.

ADULT MALE.—Similar to *cyclopum* and *weylandi* in the coloration of the under parts; the middle of the belly is pale yellowish and a grayish-green band runs across the breast; the throat is whitish, indistinctly mottled with gray, and the flanks are olivaceous. It differs, however, from the two other forms by the smaller size of the

white supraloral spots and by the absence or inconspicuousness of the black line surrounding them, by the cinnamon-brown, instead of blackish coloration of lores and cheeks, and by the smaller size of the white spots above and below the eye. The remainder of the upper parts is very much like in *cyclopum*, except that the crown averages more olivaceous, less brownish and tail and wings are definitely more olivaceous; the inner edge of the wing-feathers is light buffy.

Wing, ♂ 59, 61, 63, ♀ 58; tail, ♂ 41, 45, 45, ♀ 42.

RANGE.—Only known from the type locality at 1200 to 1800 meters.

The particular interest of this form lies in the fact that it definitely approaches the *Sericornis virgatus* group by the coloration of its face.

virgatus-group

In this group I include three subspecies, which have in common the essential color characters of *beccarii* on body and wings, but differ from the other forms of *beccarii* by the absence of black markings on the head and by the reduction or absence of the white marks on the forehead and around the eyes. One of these forms (*imitator*) has in the past been considered the same as *Ser. nouhuysi cantans* and the other two have been considered subspecies of *nouhuysi*. In my opinion they are, however, more closely related to *beccarii*, as evidenced by their smaller size, coloration of wing and under parts, and lower vertical range. The three forms: *imitator*, *jobiensis* and *virgatus* are probably not more closely related to each other than to the other forms of the species. It is for purely practical reasons (similarity!) that I have combined them in one group.

Sericornis beccarii imitator, new subspecies

No. 450828, Amer. Mus. Nat. Hist. (Rothschild collection); ♂ ad.; Siwi, Arfak Mts.; April 26, 1928; Ernst Mayr.

ADULT MALE.—Middle of throat whitish, usually in clear contrast with the cinnamonaceous buffy cheeks and ear-coverts; breast washed with grayish olivaceous; middle of belly light, frequently with a distinct yellowish wash; under tail-coverts olivaceous or just with a slight rufous wash. Upper parts, particularly the back usually distinctly greenish, not rufous olivaceous; forehead without black markings, white supraloral spots either missing or ill defined; upper wing-coverts dark, strongly contrasting with the rest of the wing; tips of alula, and of greater and medium upper wing-coverts white or whitish.

Bill reddish horn-colored, iris usually red or red-brown, not usually brown or red-brown as in *cantans*; feet pale grayish pink.

The differences between this form and *cantans* are described on p. 18.

Wing, ♂ 60, 61.5, 62, 62, 62.5, ♀ 55, 55.5, 58, 59; tail, ♂ 44, 44, 44, 46, 46, ♀ 38, 39, 39.5, 40; culmen ♂ 15-16.5, ♀ 15-16; tarsus, ♂ 20-22, ♀ 19-21.

RANGE.—Arfak Mountains from 800 m. to 1400 m.

Hartert (1930, Nov. Zool., XXXVI, p. 82) has already called attention to the fact that the series of specimens of *Sericornis* "*arfakiana*"

auctorum collected by me seems to belong to two species. On second thought, however, he treated them as color phases of one species. I entirely disagree with this point of view. In the field I considered these birds as belonging to two species and I marked them as such on some of the labels. The study of the skins has confirmed this opinion, although I admit that there are a few intermediate specimens which are difficult to assign specifically. Typical specimens of both species are, however, always well distinguishable. *Sericornis beccarii imitator* has been collected only at altitudes of 800 m. to 1400 m. In general coloration it greatly resembles *Sericornis beccarii wondiwoi*, which, however, has a different coloration of the face.

The other Arfak species, most specimens of which were collected at higher altitudes (1400 m. to 2000 m., rarely down to 1200 m.), appears to be a geographical representative of *Sericornis nouhuysi*. I have examined practically all the cotypes of *Sericornis arfakiana* Salv. (= *cantans* Mayr) in the museums of Genova, Leiden and Tring, and found all of them to belong to the species which lives in the higher altitude. There is the possibility that the two species are only altitudinal subspecies. This point of view is backed up by the fact that the forms have almost the same measurements, and that a few specimens are intermediate in their characters to such a degree that it is almost impossible to identify them. Against the theory of altitudinal races speaks the fact that the vertical ranges of *imitator* and *cantans* seems to overlap between 1200 m. and 1400 m., and also the fact that typical specimens of either form appear to be clearly representative of two distinct species: *beccarii* and *nouhuysi*. More field work and collecting will be needed to determine the exact status of the two forms, but *imitator* is different enough to be described, no matter whether one considers it as specifically or only as subspecifically different from *cantans*.

***Sericornis beccarii jobiensis* Stresemann and Paludan**

Sericornis magnirostris jobiensis STRESEMANN AND PALUDAN, 1932, Nov. Zool., XXV VIII, p. 230.—Japan Island, Geelvink Bay.

ADULT MALE.—Similar to *Sericornis beccarii imitator*, but forehead and face darker, more ochraceous cinnamon, less sand-colored; the upper parts also darker, more dark green, less olivaceous; general coloration of face and upper wing-coverts very similar; on the under parts *jobiensis* appears to be lighter than *imitator*.

Range.—Japan (= Jobi) Island Geelvink Bay.

***Sericornis beccarii virgatus* (Reichenow)**

Crateroscelis virgata REICHENOW, 1915, Jour. f. Ornith., LXIII, p. 128.—Middle Sepik River (type from the Maeanderberg).

ADULT MALE.—Similar to *jobiensis*, but more brownish throughout, particularly on wings and head; extent of white tips on upper wing-coverts variable; under parts, particularly throat and lower belly, very light; under tail-coverts olivaceous with a slight rufous tinge; forehead, lores and sides of head rufous with an indication of a buffy supraloral spot.

RANGE.—Maeanderberg (middle Sepik) at 600 m. (see also Stresemann, 1923, Arch. f. Naturgesch., LXXXIX A, fasc. 8, p. 13.)

Sericornis spilodera

This species has for a long time been separated in a monotypic genus: *Aethomyias*. There is some justification for this action. The bill of *spilodera* is reminiscent of that of some flycatchers; it is broad and has an inflated lower mandible and the rictal bristles are particularly well developed; the tarsus on the other hand is rather short. The style of coloration, however, suggests that of *Sericornis maculatus*. As in that species, the spots on the throat are well pronounced in some subspecies and reduced or missing in others. It seems best to include *spilodera* in the genus *Sericornis*, as has been suggested by Meise (1931, Nov. Zool., XXXVI, p. 319).

Sericornis spilodera spilodera (Gray)

Entomophila ? *spilodera* GRAY, 1859, Proc. Zool. Soc. London, p. 155.—Dorey, northwest New Guinea.

Aethomyias nigrifrons REICHENOW, 1915, Jour. f. Ornith., LXIII, p. 124.—Maeanderberg, Sepik region.

Gerygone stictilaema REICHENOW, 1917, Jour. f. Ornith., LXV, p. 514.—Maeanderberg, Sepik region.

ADULT MALE.—Crown sooty black; ear-coverts dull fuscous; under parts light, with the spotting on the throat well developed; abdomen, flanks and under tail-coverts pale yellowish white; back dull gray-green; tail distinctly rufous brown, tail-feathers frequently with a subterminal black bar.

Wing, ♂ 58–61, ♀ 56–61; tail, ♂ 42–46, ♀ 39–44; tarsus, ♂ 17–18.

RANGE.—Japen (= Jobi) Island, northwestern and northern New Guinea, eastward as far as Astrolabe Bay.

The populations on the Sepik, on Astrolabe Bay and on the Huon Peninsula tend progressively toward *guttata*. The name *nigrifrons* is available for those who want to separate this intermediate population.

Sericornis spilodera guttatus (Sharpe)

Aethomyias guttata SHARPE, 1882, Jour. Linn. Soc. London, Zool., XVI, p. 432.—Southeast New Guinea.

Crown greenish or, particularly toward the forehead, rufous brown; feathers of the crown frequently tipped with black; ear-coverts brown or grayish brown; under

parts rather dark, throat with large spots; middle of belly yellowish, flanks olivaceous; back light green; tail rufous brown, most feathers with a distinct sub-terminal bar.

Wing, ♂ 59-64 (61.2), ♀ 56-60 (58.0); tail, ♂ 45-49 (47.3), ♀ 46-47; tarsus, 18-19.

RANGE.—Eastern New Guinea, westward in the north to the Huon Peninsula, in the south to the Angabunga River.

Sericornis spilodera wuroi, new subspecies

TYPE.—No. 422042, Amer. Mus. Nat. Hist.; ♂ ad.; Wuroi, Oriomo River, south New Guinea; February 5, 1934; R. Archbold and A. L. Rand.

DIAGNOSIS.—Similar to *S. s. guttatus*, but crown more greenish, less rufous; ear-coverts more grayish; spots on throat averaging smaller; abdomen and flanks bright greenish yellow, not olivaceous; back very green; tail olivaceous brown; upper tail-coverts olivaceous, not rufous; under wing-coverts much lighter, less grayish. The coloration of crown, flanks and tail clearly separate this bird from *guttatus*.

Wing, ♂ 60, 61, ♀ 56, 56; tail, ♂ 46, 46, ♀ 42; tarsus, ♂ 18, 19, ♀ 17, 17.5.

RANGE.—Lowlands of south New Guinea (Oriomo River).

Sericornis spilodera granti (Hartert)

Aethomyias spilodera granti HARTERT, 1930, Nov. Zool., XXXVI, p. 85.—Snow Mts. [= Utakwa River].

Crown rather brownish, feathers without conspicuous black tips; ear-coverts rufous brown; under parts light, spots on throat small; lower belly and flanks pale yellow; back olivaceous; tail and upper tail-coverts rufous; no distinct black sub-terminal bars; smaller than *guttatus*.

Wing, ♂ 58-61, ♀ 57; tail, ♂ 43-45, ♀ 41; tarsus, ♂ 18.5-19.5, ♀ 18.

RANGE.—Nassau Range, Snow Mts.

This race is, as Hartert (*loc. cit.*) says, rather similar to *S. s. guttatus*, while on the Weyland Mts. a population occurs which is indistinguishable from typical *spilodera*.

Sericornis spilodera ferrugineus Stresemann and Paludan

Sericornis spilodera ferrugineus STRESEMANN AND PALUDAN, 1932, Ornith. Monatsber., XL, p. 16.—Waigau.

Crown rufous olivaceous; forehead rufescent; ear-coverts dull grayish rufous; under parts very light, spotting on throat almost obsolete, pale gray, not blackish; abdomen and flanks yellowish; back greenish, upper tail-coverts and tail rufous brown; some tail-feathers with indistinct black subterminal bars.

Wing, ♂ 58-59, ♀ 53-55 mm.

RANGE.—Waigau Island.

Sericornis spilodera aruensis Ogilvie-Grant

Sericornis aruensis OGILVIE-GRANT, 1911, Bull. Brit. Orn. Club, XXIX, p. 29.—Wokan, Aru Islands.

Crown rufous olivaceous, forehead paler and more buffy; ear-coverts pale buffy-gray; back bright greenish olivaceous; tail rufous; throat whitish, without any blackish or gray spots; lower belly yellowish.

Male, wing, 61; tail, 46; tarsus, 18.

RANGE.—Aru Islands.

A single specimen of this form in the Rothschild collection has already been labeled *Aethomyias* by Dr. Hartert. Although the Aru Island form is entirely unspotted on the under parts, I do not hesitate to regard it a subspecies of *spilodera*, since it agrees with that species in all of the other characters and since the Waigeu form, *ferrugineus*, represents an exactly intermediate condition.

Sericornis magnirostris

A dull and rather pale species. "It is a species of the eastern coast, . . . inhabits all the brush or jungle, . . . travels into the outlying eucalyptus forest as well, so that its range may be said to be continuous." (Campbell.) The species is apparently rather rare in the southern part of its range. The Mathews collection contains only one specimen from Victoria, and two from New South Wales (except for a series from near the Queensland border).

Sericornis magnirostris magnirostris (Gould)

Acanthiza magnirostra GOULD, 1838, Synopsis Birds Austr., pt. 4, Pl. ix.—Sydney.

Sericornis magnirostris howei MATHEWS, 1912, Nov. Zool., XVIII (1911), p. 355.—Gippsland, Victoria.

Sericornis magnirostris bunya MATHEWS, 1920, Bull. Brit. Orn. Club, XL, p. 106.—Bunya Mts., south Queensland.

MEASUREMENTS.—Wing, Victoria (type of *howei*), 55; New South Wales (Sydney district), ♂ 54, 57; New South Wales (Richmond-Tweed Rivers), ♂ 56, 58, 58, ♀ 54, 54; South and central Queensland (Bunya Mts., Gracemere), ♂ 52, 55, ♀ 49.

RANGE.—From Victoria (Western Port and Gippsland) northward through New South Wales to central Queensland (Gracemere and MacKay).

It is possible that this race can be still further subdivided along the lines suggested by Mathews, but the material examined by me is insufficient to settle this point. A single specimen from Southern Victoria (type of *howei*) differs as follows from two specimens from Gosford, N.S.W. The head is darker and definitely browner; the under parts are darker, with the throat deeper buff and the flanks more greenish; wings and tail are darker brown. The race, *howei* Mathews, must be recognized, if additional Victoria specimens show the same characters.

A series of specimens collected in northern New South Wales, at Tweed and Richmond Rivers, is lighter and more grayish on the back. Still a little paler underneath are two birds from Gracemere and Mackay, central Queensland. A single bird from the Bunya Mts. (south Queensland) is still paler, less brownish. This specimen shows practically no trace of brownish on crown, wings and tail, and no buffy coloration on throat and under tail-coverts. The back is grayish green. This is the type of *Sericornis magnirostris bunya* Mathews.

***Sericornis magnirostris viridior* Mathews**

Sericornis magnirostris viridior MATHEWS, 1912, Nov. Zool., XVIII (1911), p. 355.—Atherton Scrub, N. Queensland.

Sericornis magnirostris kerri MATHEWS, 1920, Bull. Brit. Orn. Club, XL, p. 106.—Bellender Ker Range.

CHARACTERS.—Similar to *magnirostris*, but darker and duller; back not pure green, but with a slight or strong brownish wash; back not contrasting with the brownish crown and upper tail-coverts; under parts more washed with olive-buff, flanks olivaceous; under tail-coverts deeper ochraceous; wings and tail more brownish.

MEASUREMENTS.—Wing, highlands of Bellender Ker district, ♂ 56, 58, 58, 58, 60, 61, ♀ 53, 55, 56, 58; lowlands of Cairns district, ♂ 54, 56, 57, 58, ♀ 54.

RANGE.—Lowlands and highlands of north Queensland. Specimens examined from Bellender Ker, Bartle Frere, Atherton Scrub, Tolga, Barron River, Kuranda, Johnston River, and Cedar Bay.

There is considerable variation in this series. Birds from the lowlands are paler and more grayish than specimens from the hills, thus approaching typical *magnirostris*. Some of these birds are quite pale underneath, others distinctly washed with greenish buff. Birds from Atherton Scrub and Bellender Ker are surprisingly similar to the type of *howei* (Victoria), but differ by the brownish, not green, back. The type of *kerri*, although belonging to this species, is a very unusual specimen. It is very dark on the under parts, forehead and lores, and measures larger than other birds from the same locality (wing 61, tail 48).

This species does NOT occur on Cape York.

Sericornis nouhuysi

Under this name I combine a number of high mountain forms, which had been called *arfakianus* for a long period, until I showed in 1930 (Ornith. Monatsber., XXXVIII, p. 177) that the name *Sericornis arfakianus* was preoccupied by the name *Gerygone* (= *Sericornis*) *arfakiana*. At the same time (1930, Nov. Zool., XXXVI, pp. 82-83)

Dr. Hartert proposed to include these birds with the Australian species *Sericornis magnirostris*, a proposal which has been accepted by myself and other recent workers. A renewed study of the situation has, however, led me to the conclusion that it is far better to keep the Australian and the New Guinea birds specifically separate, and to employ as the specific name of the New Guinea birds the oldest available name, which is *nouhuysi* van Oort. I have several reasons for this grouping. The Australian birds (*magnirostris*) and the New Guinea birds (*nouhuysi*) form two rather uniform groups. Their reputed similarity is mainly caused by the absence of any distinctive feature in the coloration of either group of these plain looking olivaceous birds. Furthermore there seems to be no advantage in uniting two widely separated groups in a genus which has so many similar species, as has the genus *Sericornis* in New Guinea. There is also an ecological difference between *magnirostris*, which lives in the comparatively drier subtropical forest of Australia (near sea level), and *nouhuysi*, which is restricted to the wettest high mountain forest and reaches its optimum occurrence above 2000 meters.

Sericornis nouhuysi cantans Mayr

Sericornis magnirostris cantans MAYR, 1930, Ornith. Monatsber., XXXVIII, p. 177.—New name for

Sericornis arfakiana SALVADORI, 1876, Ann. Mus. Civ. Genoa, VII, p. 962.—Arfak Mountains. Preoccupied by *Gerygone* (= *Sericornis*) *arfakiana* Salvadori, *ibid.*, p. 960.

The essential characters of this form can be most clearly described by a comparison of this form with those other forms of the genus that are most similar to it.

Similar to *S. nouhuysi oorti*, but much paler underneath with very little greenish-olivaceous wash; the rufous wash of the throat extending farther down on the breast; upper parts, including wing and tail, more rufous brown; upper wing-coverts with definite buffy-gray tips; of very much smaller size; bill narrower. Differs from *nouhuysi* by the lack of the conspicuous rufous wash of the entire under parts.

Similar to *Sericornis beccarii imitator*, but throat and breast washed with rufous, contrasting with the grayish-buff abdomen; under tail-coverts rufous; forehead, lores and feathers around the eye strongly washed with rufous; tail and crown almost always conspicuously washed with rufous; upper wing-coverts only slightly darker than the rest of the wing; light tips on alula, greater and medium upper wing-coverts narrower and buffy gray, not white; bill usually blackish; feet darker, more brownish, less pink.

Wing, ♂ 61.5, 62, 63, ♀ 57, 59, 61, 63; tail, ♂ 43, 44, 46, ♀ 41, 41, 43.5, 46, 47; culmen, ♂ —, ♀ 15.5, 15.5, 16, 16; tarsus, ♂ 21, 21, ♀ 20.5, 21, 21.5, 22.

RANGE.—Arfak Mountains above 1600 m., rarely down to 1200 m.

The status of this form in relation to *Sericornis beccarii imitator* has been discussed on p. 13.

Sericornis nouhuysi nouhuysi van Oort

Sericornis arfakiana nouhuysi VAN OORT, 1909, Nova Guinea, IX (Zool.), p. 90.—Hellwig Mountains, Oranje Range.

Entire upper parts rufous brown, more rufous on the rump and with an olivaceous wash on nape and upper back; wings and tail brown, upper wing-coverts and alula dark brown, obscurely edged and tipped with buffy rufous; forehead, lores, chin and surroundings of eyes much paler, rufous buff; breast and abdomen pale brown, with a grayish-olive wash; crissum, thighs and under tail-coverts washed with rufous. Iris dark brown, bill black, feet dark brown.

Mt. Goliath: wing, ♂ 62–67 (64.5), ♀ 60–63 (61.6); tail, ♂ 44–45, ♀ 40–45; culmen, 16; tarsus, 22–23.

Weyland Mts.: wing, ♂ 64–68 (66.8), ♀ 63–65 (63.7); tail, ♂ 44–47 (45.7), ♀ 43–44; culmen, 16; tarsus, 22–23.

RANGE.—Weyland Mts., Nassau and Oranje Ranges.

Sericornis nouhuysi stresemanni Mayr

Sericornis magnirostris stresemanni MAYR, 1930, Ornith. Monatsber., XXXVIII, p. 177.—New name for

Sericornis arfakiana rufescens STRESEMANN, 1921, Anzeiger Ornith. Ges. Bayern, I, No. 5, p. 33.—Schraderberg, Sepik Mts. Preoccupied by *Gerygone*? (= *Sericornis*) *rufescens* SALVADORI, 1876, Ann. Mus. Civ. Genova, VII, p. 961.—Hatam, Arfak Mts.

DIAGNOSIS.—Intermediate between *nouhuysi* and *oorti*. Under parts rather similar to *oorti*, but back, throat and sides of head distinctly more rufous brown.

RANGE.—Only known from the type locality (Schraderberg, 2000 meters).

Sericornis (nouhuysi?) pontifex Stresemann

Sericornis arfakiana pontifex STRESEMANN, 1921, Anzeiger Ornith. Ges. Bayern, I, No. 5, p. 34.—Lordberg, Sepik Mts.

Similar to *S. n. stresemanni*, but back less rufous brown, more olivaceous; under parts paler.

RANGE.—Lordberg (1000 m.) and Hunsteinspitze (1500 m.), middle Sepik.

This form is, as its name indicates, rather intermediate between several others and combines in some respects the characters of *Sericornis beccarii virgatus* and *Sericornis nouhuysi stresemanni*. Its altitudinal distribution is from 1000 to 1500 meters, which is more or less that of the *beccarii*-group with which it also agrees in the light-colored bill. The general coloration, however, tends to be more brownish than that of the members of the *beccarii*-group, and the upper wing-coverts never show clearly defined white tips. Either there are no tips at all, or they are indistinct greenish-gray. The seven specimens in the Berlin Museum are very variable and it seems the best for the time being to consider them a subspecies of *nouhuysi*.

***Sericornis nouhuysi oorti* Rothschild and Hartert**

Sericornis arfakiana oorti ROTHSCHILD AND HARTERT, 1913, Nov. Zool., XX, p. 503.—Bihagi, head of Mambare River.

Sericornis arfakiana keysseri STRESEMANN, 1925, Ornith. Monatsber., XXXIII, p. 59.—Rawlinson Mts. (Huon Peninsula) [type examined].

Upper parts brownish olivaceous, more brownish on the crown, more olive on the back; wings and tail brownish, upper wing-coverts without distinct light tips; forehead, lores, chin and area surrounding the eyes pale rufous buff; rest of under parts pale yellowish olivaceous; thighs and under tail-coverts washed with rufous brown.

Wing, ♂ 62-70 (65.1), ♀ 59-65 (62.2); tail, ♂ 43-50 (46.0), ♀ 42-48 (44.3).

RANGE.—Mountains of the Huon Peninsula and mountains of southeast New Guinea, up to 2800 meters.

Series from different parts of the range of this form are not always exactly alike, but there are no conspicuous differences between birds from the south coast of southeast New Guinea, those from the north coast and those from the Huon Peninsula.

***Sericornis nouhuysi monticolus* Mayr and Rand**

Sericornis nouhuysi monticola MAYR AND RAND, 1936, Mitt. Zool. Mus. Berlin, XXI, p. 246.—Mt. Albert Edward, southwest slope, at 3680 meters.

Differs from *oorti* by larger size, paler and more grayish under parts and the duller upper parts.

Wing, ♂ 65-72 (68.9), ♀ 64-67 (65.3); tail, ♂ 49-55 (51.6), ♀ 50.

RANGE.—High mountains of southeast New Guinea, known from Mt. Albert Edward and from the mountains of Kotoi district, 11,000 feet (not quite typical) (Rothschild collection, Anthony coll.).

For further details see the original description. This interesting mountain race is apparently restricted to the mountain tops, and thus to small "islands" in the wide range of *oorti*.

Sericornis perspicillatus

A well-defined species of the mid-mountain forest of New Guinea which finds optimum conditions between 1600 and 2000 meters. There are no subspecies, unless *rufescens* (Salvadori) (= *Sericornis perspicillatus goodsoni* Hartert) is included in this species.

***Sericornis perspicillatus* Salvadori**

Sericornis perspicillata SALVADORI, 1896, Ann. Mus. Civ. Genova, XXXVI, p. 99.—Moroka district, southeast New Guinea.

A conspicuous yellowish-ochre eye-ring and a black subterminal bar on the inner webs of all but the central pair of tail-feathers characterize this species. Upper parts olivaceous green, more grayish on crown and hind neck, more brownish olivaceous on lower back and rump; sides of head strongly contrasting with the crown, buffy

ochraceous, sometimes with a slight olivaceous wash on the ear-coverts; under parts buffy or pale ochraceous, washed with olivaceous on the sides of the breast and flanks; edges of wing-feathers olivaceous, paler on the outer primaries; tail olivaceous or brownish, all tail-feathers, except the central pair, with a black subterminal bar on the inner web.

Wing, ♂ 54-58, ♀ 50-56; tail, ♂ 39-44, ♀ 37-41; tarsus, 19-20 mm.

RANGE.—Mts. of southeast New Guinea, Saruwaged Mts., Sepik Mts., Oranje Range, Nassau Range and Weyland Mts.

There is a slight amount of geographical variation in New Guinea. Birds from the Weyland Mts. have the sides of the head paler, more ochraceous, less rufous, and the tail-band very broad and conspicuous, as much so as in *papuensis*. There is, however, considerable variation in regard to these two characters even in typical *perspicillatus* from southeast New Guinea and it seems best not to separate the Weyland birds as a subspecies.

Sericornis rufescens

Taxonomically this is one of the most troublesome members of the genus. It was originally described by Salvadori in 1875 as *Gerygone? rufescens*, on the basis of two males from Hatam, Arfak Mountains. Nothing more was heard of the species, until in 1928 I collected a series of about a dozen above Ditschi and at Dohunsehk, Arfak Mountains. These birds I identified in the field as ? *Sericornis perspicillatus*, but I suspected then that they were the same as *Gerygone? rufescens* Salvadori (see Ornith. Monatsber., XXXVIII, p. 176). Subsequently Dr. Hartert described the birds collected by me as *Sericornis perspicillata goodsoni*. Then I showed that *Sericornis burgersi* was related to *rufescens*, and I considered the two even conspecific at that time. I had no opportunity at that time to compare directly the types of *Gerygone? rufescens* Salvadori and *Sericornis perspicillata goodsoni* Hartert. This I was able to do in 1934, owing to the kindness of the authorities of the Genova Museum, and found that both names referred to the same bird.

In the meantime Mayr and Rand (MS.) have shown that *Sericornis burgersi*, *meeki* and *papuensis* all belong to one species and the question has arisen as to whether *rufescens* of the Arfak Mts. in western New Guinea should be considered the geographical representative of *perspicillatus* of eastern New Guinea, as suggested by Hartert, or of *papuensis*, as proposed by myself.

If we compare *rufescens* with *papuensis* and *perspicillatus* we find that it agrees in some characters with the former and in others with the latter, while in still other characters it is intermediate. It agrees with

papuensis in the general coloration of the upper parts, having both nape and back brownish olive, and lacking the contrast between the grayish-green crown and nape and the olive back of *perspicillatus*. It also agrees with *papuensis* in the broad and conspicuous black subterminal bar on the tail. In regard to the coloration of the crown and forehead, *rufescens* shows an intermediate condition. *S. papuensis* has (usually) a buffy forehead with blackish tips or edges on all the feathers of the anterior part of the crown, the feathers appearing scaly. In *S. perspicillatus* the green of the crown reaches right up to the bill, the feathers showing no blackish edges. In regard to the coloration of the sides of the face and the eye-ring, *rufescens* is also intermediate. *S. perspicillatus* has a light face which contrasts sharply with the crown, while in *rufescens* there is less contrast, and in *papuensis* there is a gradual blending between sides of face and crown; the eye-ring of *perspicillatus* is conspicuously tawny or yellowish ochre, in *rufescens* it is pale ochre, sometimes mottled with dusky brown, while in *papuensis* it is dull brown, more or less mottled with blackish, particularly in the anterior part. There are apparently no conspicuous differences in regard to the wing between all three species. The following are the characters in which *rufescens* agrees with *perspicillatus*: first, size; *rufescens* is a small bird, even smaller than *perspicillatus*, while *papuensis* is a large, robust bird. The bills of *rufescens* and *perspicillatus* are fairly broad at the base and then become very slender near the tip, while *papuensis* has a more typical *Sericornis* bill. The ear-coverts have blackish bases in *papuensis* but lack them in the other two species. *S. papuensis* rarely occurs below 2000 m. and is apparently most common between 2500 m. and 3000 m., while the ranges of *rufescens* and *perspicillatus* are from about 1500 to 2400 meters.

It seems impossible at the present time to determine whether *rufescens* is a geographical representative of *papuensis* or of *perspicillatus*. I therefore propose to treat it as a separate species. Every species of the genus *Sericornis*, that I have had an opportunity of observing in the field, had its own peculiar song, and probably it will be decided finally by a field ornithologist whether *rufescens* is more closely related to *papuensis* or to *perspicillatus*.

Sericornis rufescens (Salvadori)

Gerygone ? *rufescens* SALVADORI, 1876, Ann. Mus. Civ. Genova, VII (1875), p. 961.—Hatam, Arfak Mts. [type examined].

Sericornis perspicillata goodsoni HARTERT, 1930, Nov. Zool., XXXVI, p. 84.—Mt. Lehuma, Arfak Mts. [type examined].

Upper parts brownish olivaceous, warmer on lower back and rump; sides of face and eye-ring buff with a brownish tinge, ear-coverts darker; lores and foremost part of forehead lighter than crown, more buffy; under parts pale ochraceous, lighter, almost whitish, on the belly; edges of wing-feathers and wing-coverts slightly more greenish than the back, edges of outer primaries paler; tail olivaceous brown, black subterminal bar well pronounced on all but the central pair of tail-feathers; the two or three outermost pairs of tail-feathers sometimes with broad fulvous tips.

Wing, 6 ♂ 54-56 (54.5), 5 ♀ 50-52 (51.0); tail, 6 ♂ 38-40 (39.4), 4 ♀ 37-39 (37.8); culmen, 13-14; tarsus, 18-19; weight, 7.5-9.5 gr.

RANGE.—Arfak Mountains (1500 m. to 1800 m.).

Sericornis papuensis (De Vis)

The status and the variation of this species have been discussed in detail by Mayr and Rand¹ in the report on the birds of the Archbold-Rand New Guinea Expedition of 1933. This is a robust species with a strong bill and a long and broad tail. The feathers on the head appear scaly and the black bar across the tail is always well developed.

Sericornis papuensis papuensis (De Vis)

Acanthiza papuensis DE VIS, 1894, Ann. Rep. Brit. New Guinea, (1893-1894), p. 102.—Mt. Manaao, southeast New Guinea.

Gerygone brunnea DE VIS, 1897, Ibis, p. 378.—Southeastern New Guinea.

For a detailed discussion of the extremely variable plumage see Mayr and Rand.¹ Young birds are usually very greenish.

Wing, 15 ♂ 57-61 (58.5); 4 ♂ imm. 55-56; 14 ♀ ad. 53-58 (55.0); 5 ♀ imm. 55-56.

RANGE.—High mountains of southeast New Guinea from 2000 m. to 3680 m.

Sericornis papuensis meeki Rothschild and Hartert

Sericornis meeki ROTHSCHILD AND HARTERT, 1913, Nov. Zool., XX p. 503.—Mt. Goliath, Oranje Range.

Very similar to the most greenish specimens of *S. p. papuensis*, but throat with a deeper and more distinct rufous wash; lower belly and under tail-coverts deeper olivaceous; upper parts similar, but forehead greenish, not buffy or whitish; bill shorter.

Two females: wings, 54, 56; tail, 38, 39; culmen, 13.5, 14; tarsus, 20.5, 20.5.

RANGE.—Oranje Range, Snow Mts.

Considering the extreme variability of *papuensis* it might be considered unwise to recognize a race founded on such slight characters as those of *meeki*; the two typical specimens of *meeki*, however, cannot be matched by any of the 50 specimens of *papuensis* in the Amer. Mus. of

¹ Mayr, E., and Rand, A. L., 1936, Bull. Amer. Mus. Nat. Hist., LXXIII, Art. I, pp. 120-126.

Nat. Hist. More material of *meeki* will have to be examined to determine the validity of this subspecies.

***Sericornis papuensis bürgersi* Stresemann**

Sericornis bürgersi STRESEMANN, 1921, Anzeiger Ornith. Ges. Bayern, I, 5, p. 34.—Schraderberg, Sepik Mountains.

Similar to *S. p. papuensis*, but averaging much browner on crown, back and wings; lores, cheeks, ear-coverts and sides of head deep rufous brown, not greenish or ochraceous; wash of under parts more brownish, less greenish than in *papuensis*; tail very rufous brown.

Four males: wing, 59.5, 59.5, 60.5, 61; tail, 41, 42, 42, 44; culmen, 13, 13.5; tarsus, 20–21.

RANGE.—Sepik Mountains (Schraderberg, 2000 m.) and Weyland Mountains (2400 m.).

The type of this race is a rather greenish specimen and agrees fairly well with some specimens of *papuensis*, except for the brownish sides of the head; the three paratypes are, however, more brownish than any of the southeast New Guinea specimens.

Birds from the Weyland mountains are not as dark and brownish as typical Sepik Mountain specimens, but are better referred to this race than to *papuensis*.

Sericornis arfakianus

A small, greenish species, with light under parts. The tail with an inconspicuous dark subterminal bar. Lives in the hill forest between 800 m. and 1600 m.

***Sericornis arfakianus arfakianus* (Salvadori)**

Gerygone ? *Arfakiana* SALVADORI, 1876, Ann. Mus. Civ. Genova, VII, p. 960.—Arfak Mts.

Upper parts grayish green, more olivaceous on lower back and rump; wings greenish, outer edges of primaries with a brownish tinge; tail brownish olive, with a rather obscure dark subterminal bar; lores and sides of head grayish green; underparts yellowish white without any streaks, but with a slight greenish wash, which is more grayish on the breast and more olivaceous on the flanks.

Wing, ♂ 53–56, ♀ 49–51; tail, ♂ 38–41, ♀ 35–38; tarsus, 18–20.

RANGE.—Arfak Mts., Wandammen Mts. (Mt. Wondiwoi) and Cyclop Mts.

Females are similar to the males, but smaller and paler underneath.

Birds from the above-mentioned three mountain ranges do not form a uniform population. Birds from the Wondiwoi Mt. have a buffy wash underneath and are above much more brownish olive. while birds from

the Cyclops Mts. are somewhat intermediate. The differences do not seem important enough to warrant the recognition of subspecies.

Sericornis arfakianus olivaceus Salvadori

Sericornis olivacea SALVADORI, 1896, Ann. Mus. Civ. Genova, XXXVI, p. 100.—Moroka, southeast New Guinea.

Sericornis pusilla ROTHSCILD AND HARTERT, 1903, Nov. Zool., X, p. 228.—Mt. Gayata, southeast New Guinea [type examined].

Similar to *arfakianus*, but under parts, particularly in the males, with grayish-olive streaks; lores and sides of face darker grayish olive; upper parts more olivaceous and tail brown; subterminal bar on tail more conspicuous.

Wing, ♂ 52–55, ♀ 49–52; tail, ♂ 40–41, ♀ 38–39.5; culmen, 14; tarsus, 18–20.

RANGE.—Mts. of southeast New Guinea, Saruwaged Mts., Sepik Mts. and Weyland Mts.

Birds from the Weyland Mts. have the streaking of the under parts not very pronounced, but otherwise agree well with southeast New Guinea birds.

AMERICAN MUSEUM NOVITATES

Number 905

Published by
THE AMERICAN MUSEUM OF NATURAL HISTORY
New York City

January 14, 1937

NOTES ON THE TAXONOMY AND OSTEOLOGY OF TWO SPECIES OF *MESOPLODON*

(*M. EUROPAEUS* Gervais, *M. MIRUS* True)

By H. C. RAVEN

During the winter of 1933-1934 two specimens representing two species of rare beaked whales were cast up on Rockaway Beach on the south shore of Long Island, approximately twenty miles from New York City. Through the kindness of the Rockaway Police and other officials the American Museum was notified in each case and the specimens were guarded until they could be sent for. The taxonomy and osteology of these specimens will be treated in the present paper. Parts of the soft anatomy will be described in a later number of Novitates.

Now that the skeletons of the two animals have been prepared it is possible to identify them with a fair degree of certainty. The first is referable to *Mesoplodon europaeus* (Gervais) and the second to *Mesoplodon mirus* True.

Mesoplodon europaeus (Gervais)

Dioplodon europaeus Gervais, 1845; VAN BENEDEN AND Gervais, 1880.

Dioplodon Gervaisi Deslongchamps, Eug., 1866.

Neoziphius europaeus Gray, 1871.

Mesoplodon europaeus Flower, William Henry, 1878; True, 1910 (part).

The type and for a long time the only known example of this species of beaked whale was one found about 1840 (Flower) floating on the surface of the sea at the entrance of the English Channel. It was discovered by the captain of a French merchant ship, who saw gulls feeding on the carcass. He had the head cut off and towed it into port. Later the skull was described and figured by Gervais and eventually deposited in the Museum at Caen in France, but some later authors doubted the validity of the species. However, on March 28, 1889, a young male beaked whale twelve and a half feet long was caught at Atlantic City, New Jersey, which proved to be of the same species. The skeleton, a cast, and photographs of this specimen were secured for the United States National Museum and it was later described in detail by True.

The third recorded specimen of this rare species is the one about to

be described, which was stranded on Rockaway Beach, Long Island, on December 22, 1933. Mr. G. G. Goodwin of the Department of Mammals in The American Museum of Natural History, with assistants from the Department of Preparation, reached the site of the stranded whale shortly before dark on the day it came ashore. He was able to get photographs of the animal by the fading light, in which some of its external characters are recorded. Mr. Goodwin has kindly allowed me to use the photographs and the measurements he made of the animal in the flesh and it is partly from these records that the following description is



Fig 1. *Mesoplodon europaeus* Gervais, stranded on Rockaway Beach, Long Island, December 22, 1933. A M N H No. 90051. Photograph by Mr. G. G. Goodwin.

taken. The photographs show the general form of the animal and also the pattern of the markings on the ventral surface and the genital and mammary grooves. The latter show conclusively that it was a female.

The skeleton was roughed out on the beach and transported directly to the Museum, where a plaster cast of part of the head was made. Before the skull was cleaned I was able to remove the suprarrostral tissues for a study of the nasal structures, including the spermaceti organ.

EXTERNAL FEATURES

COLOR.—The general color of the animal was slaty black above, becoming somewhat lighter on the sides and below. The position of the navel was marked by a light grayish spot and light grayish areas extended irregularly along the sides and along the under surface to the fore part of the throat. A pure white area, irregular in shape and about ten inches in diameter, enclosed the genital and mammary grooves.

True (*loc. cit.*, p. 22) makes the following statement concerning the color of the Atlantic City specimen: "The natural color of the specimen had largely disappeared before I examined it, but Captain Gaskell and others who saw it while still fresh agreed that it was very dark slate-gray on the back, lighter on the sides, and whitish on the belly. I observed that a broad area between the pectoral fins was slate-gray, and contrasted with the white of the throat and belly. The whitish color ended somewhat abruptly and irregularly at the anus, and the flukes, as well as the pectoral and dorsal fins, were probably very dark slate-gray, or blackish, when fresh."

It is thus evident that the color of the two specimens was very much alike but there was considerable variation in the irregular markings of the ventral surface and sides.

FORM.—The appearance of the animal (Figure 1) was slender and fusiform, agreeing very closely with the photographs of the Atlantic City specimen mentioned above. The head behind the mouth was nearly circular in coronal section. From that point forward it tapered to the snout, first convexly, then concavely. This contour was more pronounced along the mid-dorsal line than elsewhere. The lower jaw protruded slightly beyond the tip of the upper jaw. The eyes were situated on slight eminences and a few inches behind them were the extremely small openings of the external auditory meati, situated in very slight depressions. The gular grooves were not noticed by the men who secured the specimen and the skin of the throat had been removed before I saw it.

There was a very slight constriction to indicate the presence of the neck. The thickest part of the body was considerably behind the extremity of the flippers as they lay in their normal position against the sides of the body. The tail was decidedly compressed, so that proximal to the flukes its depth dorsoventrally was much greater than its thickness from side to side. On the ventral side of the tail a keel, beginning at a point about midway between the anus and the base of the flukes, extended almost to the distal border of the flukes. Along the dorsal

surface of the tail a corresponding keel extended from the dorsal fin to approximately the same position on the dorsal surface of the flukes.

The flukes were very wide, being equivalent to $3/10$ the total length of the animal. There was a faint indication of a notch between the two halves of the flukes, though their posterior margin was convex medially and concave near the extremities. The concavity of the posterior margin of the flukes, laterally, was more pronounced than in the specimen figured by True (Pl. xli, figs. 1, 2).

The flippers were very small. The radial border was rather thick and rounded, whereas the opposite border was quite thin.

The photographs do not show the dorsal fin. It was said to have been small and set far back, about over the vent.

The following measurements were taken by Mr. G. G. Goodwin of the animal in the flesh:

Greatest length	4670 mm.
Blow-hole to end of snout	570
Eye to end of snout	580
Width of blow-hole	88
Length of flipper	355
Greatest width of flipper	125
Width at base of flipper	102

SKELETON

SKULL.—As the type specimen of this species is represented only by the skull and mandible, the most important characters for identification are of these parts.

The diagnostic characters of *M. europaeus* are readily seen in the figures, thus a detailed description of the material is considered unnecessary. In a comparison of the dorsal aspect of the skulls, the figures of the three known specimens of this species show that they agree very closely one with the other (Fig. 2 A, B, C), although they represent both sexes and three different growth stages. The relative age of each may be judged by the extent of coössification of the presphenoid and vomer, which in adults comes to occupy the entire mesirostrum. In young specimens it is formed by the vomer below and bounded on either side above by the medial borders of the premaxillaries (Fig. 3). In the type specimen (Fig. 2C) the entire mesirostral groove is filled with bone. In the United States National Museum specimen from Atlantic City (Fig. 2A) no ossification shows, while in the Rockaway Beach specimen (Fig. 2B) the posterior half of the distance from the narial openings to the tip of the rostrum is filled with bone.

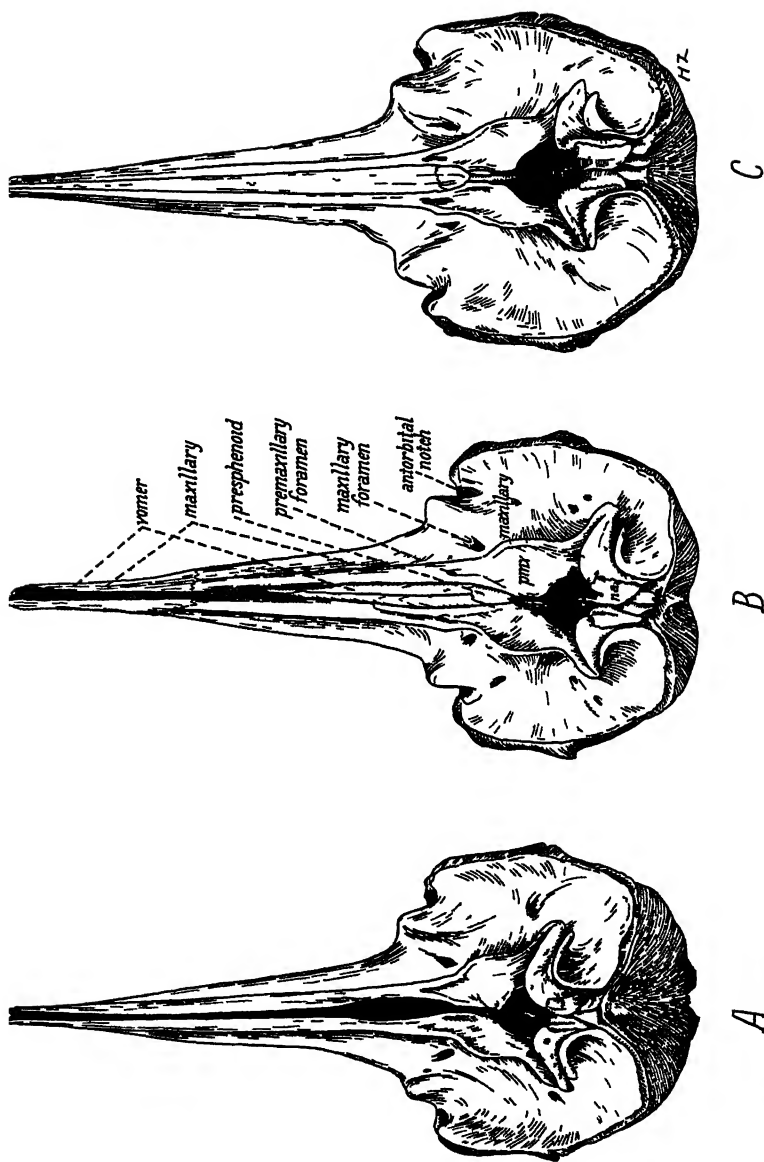


Fig. 2. Dorsal view of the skulls of three specimens of *Mesoplodon europaeus*, showing specific resemblances in morphology and three different stages in the ossification of the mesostrum, due to age. A, youngest specimen, after True; B, A.M.N.H. specimen from Rockaway Beach; C, type specimen, after Blasius.

Flower used the lateral basirostral groove as an important character in separating the various species of *Mesoplodon* into two groups. This lateral basirostral groove of Flower is synonymous and homologous with the maxillary alveolar groove of less specialized mammals. The species of *Mesoplodon* having this groove frequently retain a number of small peg-like upper teeth (see figure of *M. grayi* Hale, Herbert M.). It is also analogous to the alveolar groove in the mandible. Flower described it as a groove at the base of the rostrum, commencing posteriorly in a blind pit below the tubercle of the maxillary, situated in front of the antorbital notch and bounded above and below by sharply defined prominent ridges, both formed by the maxillary. This groove is deeper in *M. grayi* than in any other species but is also readily seen in photographs of the skulls in side view of *M. layardi* and *M. densirostris*, and is entirely absent in other species, including *europaeus*.

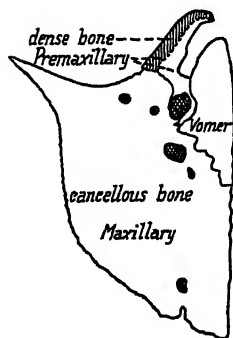


Fig. 3. A tracing of a coronal section through the rostrum of *Mesoplodon europaeus*, showing the vomer expanding dorsally, partly filling the mesirostral groove. At a younger stage the dorsal surface of the vomer was concave at this point, whereas in old individuals it fills the mesirostrum even with the premaxillary.

The relative position of the maxillary to the premaxillary foramen is apparently a constant character in a given species. The conspicuous maxillary foramen which affords an exit for the principal branch of the nervus infraorbitalis is situated close to the lateral border of the premaxillary bone, where the latter is constricted at the base of the rostrum. The premaxillary foramen in *Mesoplodon* is always located at the rostral border of the very slight depression that marks the site of the ventral spiracular, or premaxillary sac. In some species of *Mesoplodon* the premaxillary foramen is in advance of the adjacent maxillary foramen, in other species behind the maxillary foramen. This depends upon the size and shape of the sac. In *M. europaeus* the sac is relatively long, consequently the premaxillary foramen is decidedly in advance of the maxillary foramen.

1937] TAXONOMY AND OSTEOLOGY OF MESOPLODON

TABLE I.—Dimensions of the type and three other known skulls of *Mesoplodon europaeus*

	English Channel type ¹ Mus. Caen, France ♂ ? adult	Atlantic City, N. J. U.S.N.M. 23346 ♂ young	Rockaway Beach, N. Y. A.M.N.H. 90051 ♀	Middle Key, Florida A.M.N.H. 121894
			98:	98:
Total length	765 mm.	675 mm.	780 mm.	775 mm.*
Tip of rostrum to rostral border of anterior nares	550		570	575*
Tip of rostrum to a line joining antero-lateral processes of maxillaries	430	427	460	465*
Tip of rostrum to process of maxillaries between the pterygoids	480		475	450*
Tip of rostrum to posterior end of pterygoids		525	635	610*
Tip of rostrum to most anterior point of the palatines	370		390	405*
Height from vertex to ventral point of pterygoids		256	300	290
Width of rostrum at highest point of anterior palatine suture	120		105	105
Depth of rostrum at highest point of anterior palatine suture	77	40	64	70
Diameter of orifice of posterior nares immediately behind pterygoid processes	93		85	100
Greatest diameter of orifice of anterior nares	55	42	53	55
Greatest breadth of premaxillae proximally		142	158	151
Same, in front of anterior nares		104	106	100
Greatest width of skull	370		363	365
Breadth between orbits		287	330	320
Breadth at antorbital notches		182	201	195
Breadth between temporal fossae		208	236	217
Breadth of foramen magnum		34	43	45
Length of mandibular ramus	665	565	657	600*
Length of symphysis	125	116	160	110*
Tip of mandible to anterior border of tooth	75		110	55*
Greatest depth of mandible		101	111	110

¹ The measurements of the type are taken from Brasil, those of the Atlantic City specimen from True.

*75 mm. has been added to this measurement as approximately that much of the rostrum is missing.

In several species of *Mesoplodon* the antorbital notch is interrupted by a protuberance of the maxillary, which projects to a variable degree and from which a ridge of more or less prominence extends backward. In *M. europaeus* both the protuberance and the ridge extending back from it are conspicuous.

TABLE II.—Relative proportions of skull.

Percentage of width to length of skulls in *M. europaeus*:

SPECIMEN	LENGTH	WIDTH	PERCENTAGE
Type	765 mm.	370 mm.	48.3
Rockaway Beach, L. I.	780 mm.	363 mm.	46.5
Florida	775 mm.	365 mm.	47.0
Variation 1.8%			

Percentage of depth to width of rostrum at the highest (most rostral) point of the anterior palatine suture:

SPECIMEN	DEPTH	WIDTH	PERCENTAGE
Type	77 mm.	120 mm.	64.1
Rockaway Beach, L. I.	64 mm.	105 mm.	60.9
Florida	70 mm.	105 mm.	66.6
Variation 5.7%			

Percentage of length of symphysis to length of mandibular ramus:

SPECIMEN	MANDIBLE	SYMPHYSIS	PERCENTAGE
Type	665 mm.	125 mm.	18.7
Atlantic City	565 mm.	116 mm.	20.5
Rockaway Beach, L. I.	657 mm.	160 mm.	24.3
Variation 5.6%			

The mandible (Figs. 4, 5A) of *M. europaeus* exhibits characters by which it may be distinguished from that of any other member of the genus. The symphysis is very short yet well defined and rather deep. The tooth which is compressed is entirely opposite the symphysis in young specimens but occupies more space when fully erupted and is not at the tip of the mandible. In the type specimen (Fig. 4C), which is much older than either of the others, the tooth is fully erupted and the alveolus about it is much deeper from dorsal to ventral border of the mandible than in the younger specimens; in these only the tip of the tooth projects above the alveolar border.

The table showing relative proportions of width to length of skull (Table II) shows that in *M. europaeus* the range of variation in these features is surprisingly small.

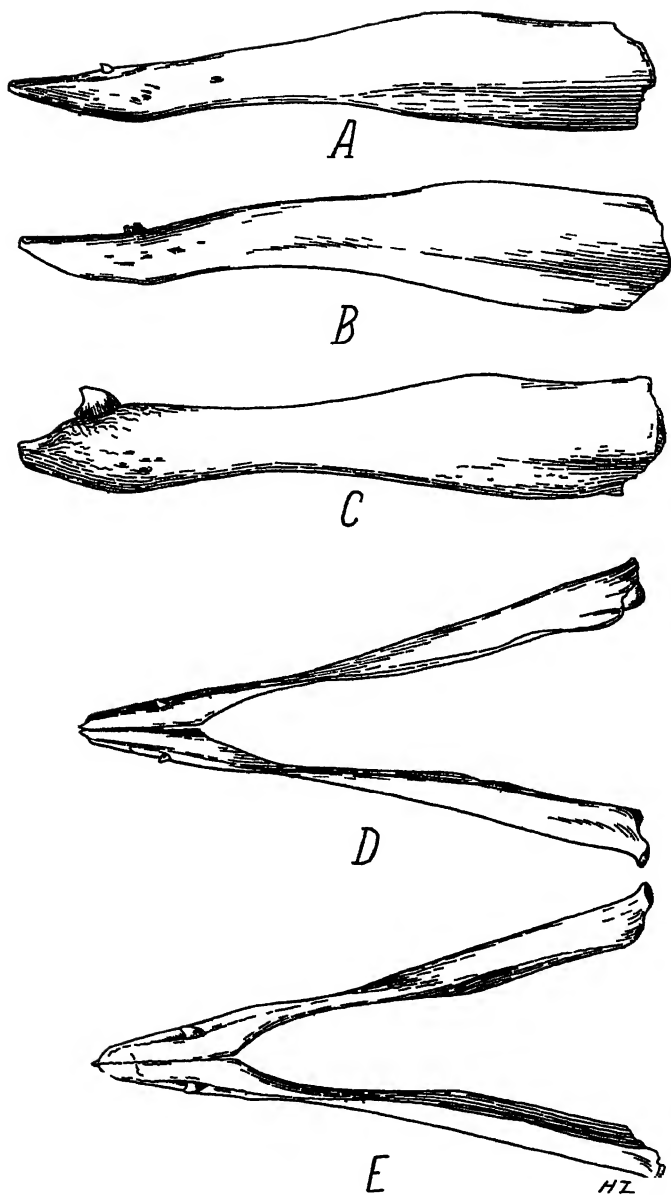


Fig 4. Mandibular rami of *Mesoplodon europaeus* A, lateral, and D, dorsal view, redrawn from True, of United States National Museum specimen from Atlantic City, New Jersey. B and E, lateral and dorsal views of American Museum of Natural History specimen from Rockaway Beach, Long Island. C, lateral view of type, redrawn from Brasil.

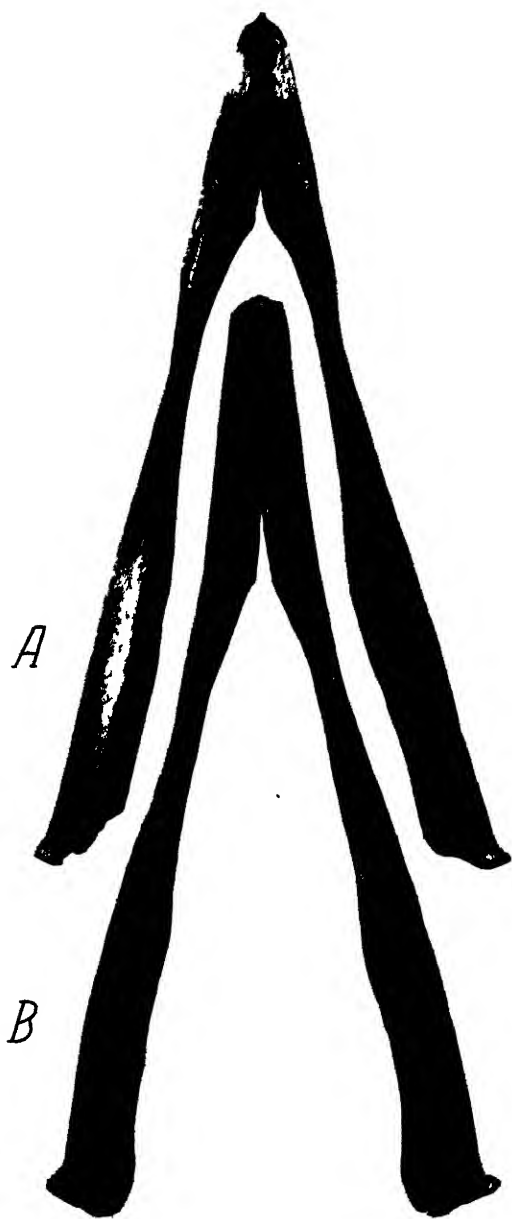


Fig. 5. Mandibles of A, *Mesoplodon europaeus*; and B, *Mesoplodon mirus*, showing the relative position of the teeth, and symphyseal length.

VERTEBRAE.—The postcranial skeleton agrees closely with that of the specimen of *M. europaeus* from Atlantic City, New Jersey, described by True. A comparison of the vertebral formulae of these specimens follows:

Rockaway Beach, N. Y. ♀ C.7; Th. 10; L. 11; Ca. 19 = 47

Atlantic City, N. J. ♂ C.7; Th. 9; L. 11; Ca. 20 = 47

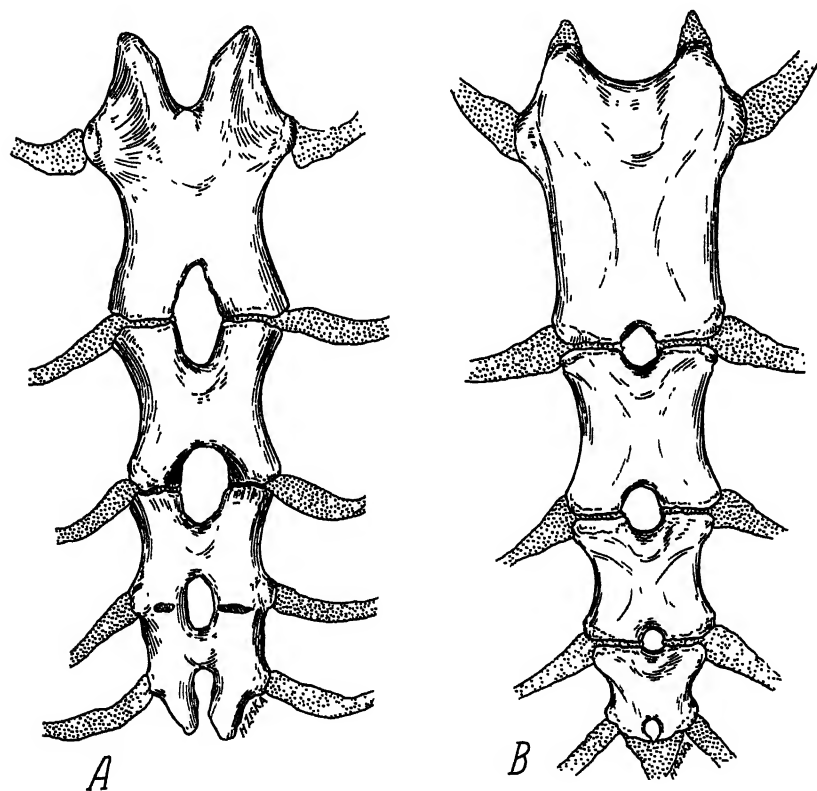


Fig. 6. A, sternum of *Mesoplodon europaeus*; B, that of *Mesoplodon mirus*.

True (1910, p. 16) states that an additional pair of ribs probably existed originally, which would make the formula: C. 7; Th. 10; L. 10; Ca. 20 = 47.

The first three cervicals are anchylosed together. The spinous processes of the caudal vertebrae decrease rapidly in height, as in *M. mirus* (Fig. 15), and the ten terminal caudals are without spinous pro-

cesses. Beneath the proximal caudal intervertebral spaces are nine chevrons, followed by nine intervertebral spaces without chevrons.

The first seven pairs of ribs have both head and tubercle. The

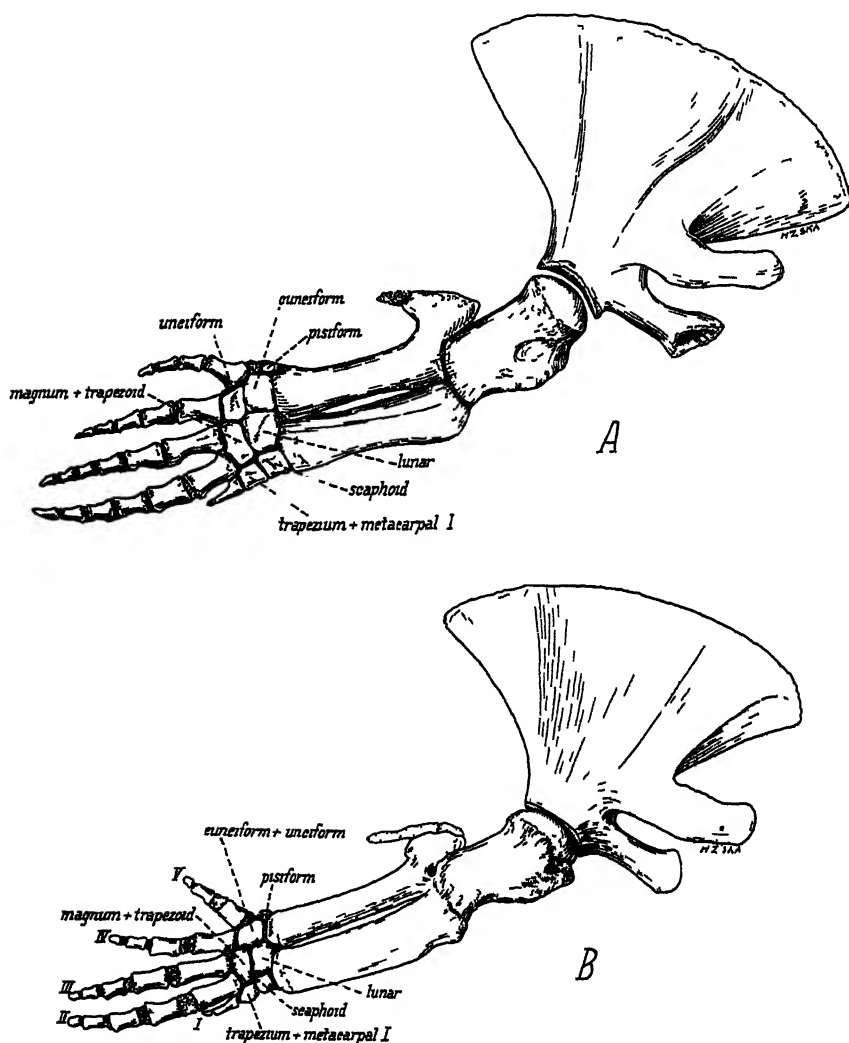


Fig. 7. Lateral aspect of the skeleton of the pectoral limb of A, *Mesoplodon europaeus*, and B, *M. mirus*.

remaining three pairs have only a single vertebral attachment. Five pairs of ribs were attached to the sternum.

STERNUM.—The sternum (Fig. 6A), consisting of four sternebrae, is very similar to that of the Atlantic City specimen (True, 1910, Pl. XIII, fig. 2). The chief difference is that in the present specimen the lateral margins of the manubrial processes are slightly concave, whereas they are convex in the younger animal. Otherwise the outlines are very similar and the fenestrae of corresponding size. The form of the sternum is, as True pointed out, very like that of *M. bidens* figured by Grieg (1904, p. 32, Fig 12), but in *M. europaeus* the elements are slightly longer in proportion to their width.

PECTORAL LIMB.—A comparison of True's description and figure of the scapula of the Atlantic City specimen with those of the Rockaway Beach and Florida specimens in The American Museum of Natural History shows that a diagnostic character of *M. europaeus* is the way in which the acromion is turned forward and toward the vertebral border of the scapula; it has a decided thickening proximally, with a convex lower border. The coracoid process is about the same length as the acromion but thicker, with the distal extremity expanded and turned laterally. The coracoid is directed forward in the same plane as the blade of the scapula and forms a right angle with a line drawn from the middle of the vertebral border through the center of the glenoid.

The bones of the limb present the usual compressed form, with very little motion possible at the articulations distal to the scapulohumeral joint. There are four carpals in the proximal row, of which the pisiform is represented by a mere nodule. In the distal row there are three bones. The carpals in this specimen thus agree in detail with the figure and description of the U. S. National Museum specimen from Atlantic City and as to number and general position with those of *M. grayi* figured by Flower (1879, Trans. Zool. Soc., Pl. LXXIII, fig. 1).

A comparison of the carpus of *Mesoplodon* with that of other odontocetes, including excellent roentgenograms of a young adult *Monodon*, leads to the belief that in *Mesoplodon europaeus* the trapezium and first metacarpal are represented in the adult by one element, also that the trapezoid and magnum are coalesced.

The cuneiform and unciform are distinct in this species and united in *M. mirus*.

The phalangeal formula is: I 2; II 5; III 5; IV 4; V 3.

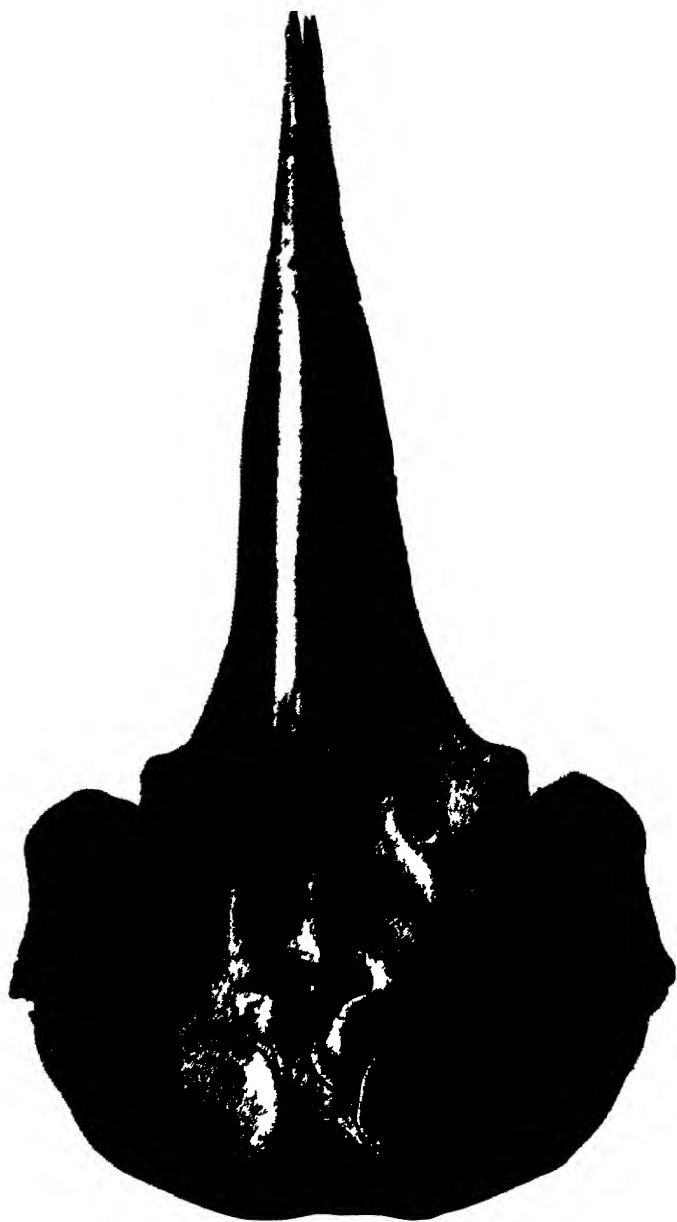


Fig. 8. *Mesoplodon europaeus*, dorsal aspect of skull.

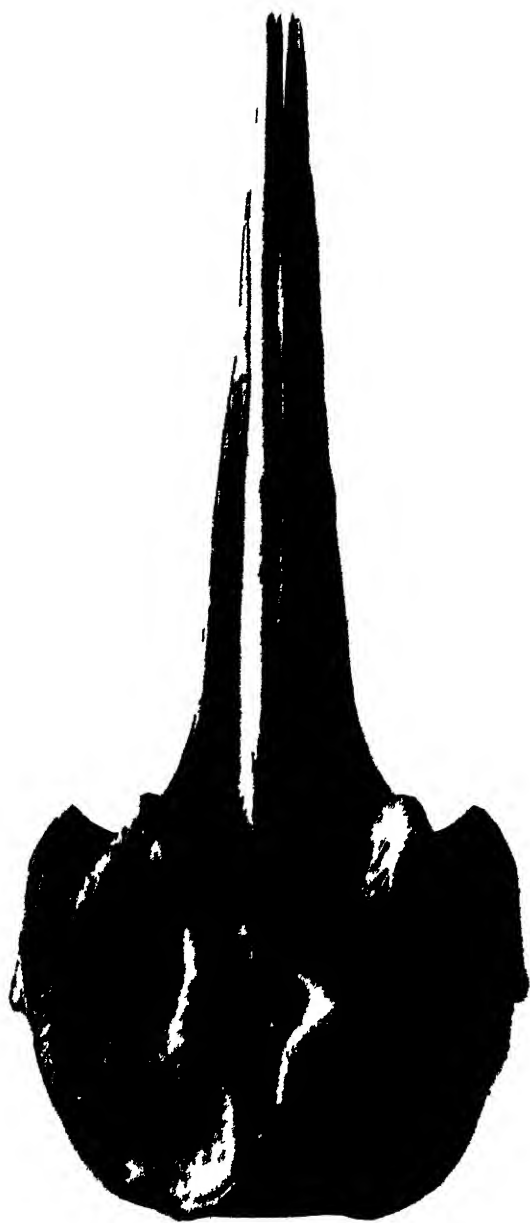


Fig. 9. *Mesoplodon mirus*, dorsal aspect of skull

Mesoplodon mirus True

Mesoplodon mirum TRUE, 1913.

Mesoplodon hectori ANDERSON, 1901.

Mesoplodon mirus HARMER, 1919.

Mesoplodon pacificus LONGMAN, 1926.

The second beaked whale to be secured for the American Museum during the winter of 1933-1934 was stranded at Edgemere, Rockaway Beach, Long Island, on January 14, 1934. At first it was thought to be the same species as the former whale, which was stranded three weeks earlier, but when the skull was cleaned it could be positively identified as *Mesoplodon mirus*, or True's beaked whale.

The type specimen of this species was taken at Beaufort Harbor, North Carolina, on July 26, 1912, and later described and figured by Dr. Frederick W. True in the Proceedings of the United States National Museum.

In 1919 Sir Sidney F. Harmer referred two more specimens to this species. One of them had been stranded in Galway Bay, Ireland, in 1899, and described as *Mesoplodon hectori* by R. J. Anderson in 1901. The other was stranded at Liscannor, County Clare, Ireland, on June 9, 1917. On March 2, 1906, Dr. G. M. Allen and C. E. Brown collected one at Wells Beach, Maine, a male fifteen feet ten inches long, of which the skeleton and a cast are preserved in the museum at the Boston Society of Natural History. This was later recognized by Dr. Allen as belonging to True's species *mirus*.

As shown below, it seems probable that a South Pacific subspecies of this form is represented by the type of *Mesoplodon pacificus* Longman.

EXTERNAL FEATURES

COLOR.—Upper parts black, becoming slate-colored on the side and under parts. Lower sides and under parts with elongate patches of light purple that may have been pinkish or whitish in life. Some pure white markings about the navel and larger areas of pure white surrounding the urogenital and anal apertures.

The color of the type specimen was given as: "Back, slate black; lower sides, yellow purple flecked with black; median line of belly somewhat darker; a grayish area in front of vent; fins the color of the back."

With due allowances for post mortem changes, the present specimen shows no significant difference in color from the type.

FORM.—Fusiform, slender when viewed ventrolaterally, the angle at which the accompanying photograph was taken (Fig. 15); less so in

direct lateral view. Body slightly compressed laterally and caudal peduncle decidedly so, though somewhat less than in *Mesoplodon densirostris* figured by Andrews.

Laterally there was a very slight constriction to indicate the neck, which could not be seen from the side.

The flippers were low on the sides of the body and pressed into slight depressions in the sides, which may have been purely a post mortem condition; they were not sharply pointed. The ventral or radial border was thickened and nearly straight; the opposite border tapered to a thin edge and was rounded distally.

The dorsal fin (Fig. 14) was placed far back, corresponding to that of the type.

The flukes were broad both caudorostrally and laterally, their posterior margin concave laterally and evenly convex medially; without a conspicuous notch.

The dorsal and ventral caudal keels extended about halfway to the extremity of the flukes in the midline.

TABLE III.—External measurements of *M. mirus*

Adult ♀ A.M.N.H. No. 90053

Total length (between uprights)	16'	=	4870 mm.
Total length (over curves)	16' 8"	=	5080 mm.
Tip of rostrum to rostral border of dorsal fin	9' 10"	=	3000 mm.
Length (caudorostrally) of dorsal fin	11"	=	280 mm.
Dorsal fin to tip of flukes	5' 5"	=	1650 mm.
Tip of rostrum to eye	2' 1½"	=	645 mm.
Tip of rostrum to proximal border of flipper	3' 8¾"	=	1135 mm.
Greatest circumference	8' 8"	=	2640 mm.
Circumference at vent	8' 6"	=	2590 mm.

SKELETON

SKULL.—(Figs. 9, 11, 13) True gives the following diagnostic skull characters for the type of *M. mirus*: "Teeth at the extremity of the mandible, small, entirely concealed by the integument (in the adult female). Mandibular symphysis one-fourth the length of the mandible. No basirostral groove. External free border of the lachrymal bone one-half the length of the orbit; its anterior end curved upward and appearing on the superior surface of the skull where it joins the antero-external angle of the frontal plate of the maxilla. Maxillary prominences short and directed obliquely outward anteriorly, the extremity close to the maxillary notch. Maxillary foramina behind the premaxillary foramina. Frontal plates of maxillae approximately one-half as broad as long."



Fig 10 *Mesoplodon europaeus*, ventral aspect of skull



Fig 11. *Mesoplodon murus*, ventral aspect of skull



Fig 12 *Mesoplodon europaeus*, right side of skull with mandible attached

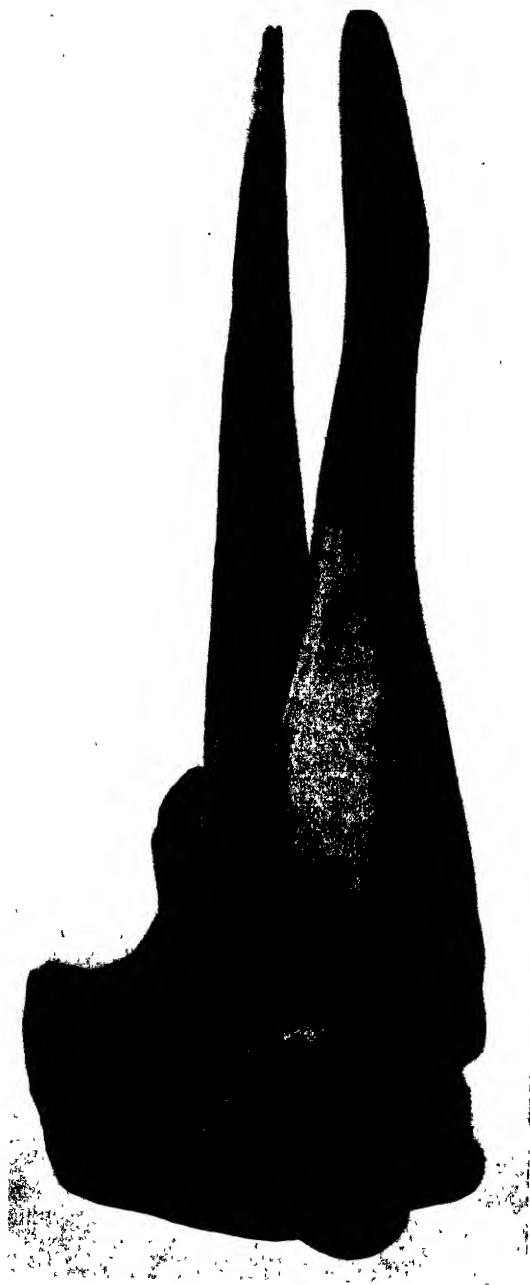


Fig. 13. *Mesoplodon mirus*, right side of skull with mandible attached.

All these diagnostic characters are well shown in the present specimen and can be clearly seen in the figures. It must be noted that there is a distinction between the maxillary prominences and the maxillary ridges.

The maxillary prominences are short and directed obliquely outward but the maxillary ridges, which are continuous anteriorly with the lateral border of the prominences, begin near the lateral border of the maxillary flanges behind and above the postorbital process of the frontal and extend forward and inward, terminating as the medial border of the maxillary notch (Fig. 9).

The mesirostral groove is, in the young of *M. europaeus* and *mirus*, a trough formed ventrally by the elongated vomer, which is concave dorsally throughout its length and laterally covered by the rostral por-



Fig. 14. Outline of dorsal fin of *Mesoplodon mirus* traced from a photograph

tion of the premaxillae. With increasing age the presphenoid ossifies, filling the proximal part of the groove; then the vomer begins filling in the mesirostral groove with osseous tissue until in very old individuals the groove is completely eliminated. Three stages in this process are shown in figure 2, while figure 3 shows a coronal section through the right half of the rostrum of a young adult specimen of *M. europaeus*, in which the vomer has already changed from concave to convex and partly filled the mesirostral groove.

A section of the rostrum was cut in order to ascertain the relations of the bony elements. True (p. 654) states: "The mesirostral bone occupies the proximal two-thirds of the vomerine trough. It is depressed below the upper surface of the premaxillae and divided unsymmetrically into two flat portions, the surfaces of which are inclined toward each other." The section showed that the mesirostral groove becomes filled only with bone by the expansion of the vomer itself and that there is at least in these forms, no independent mesirostral bone.

In 1926 Mr. Heber A. Longman described and figured *Mesoplodon pacificus* from the Queensland coast of Australia, based upon "an unusually large skull and mandible of a Beaked Whale found at Mackay in 1882." After studying Longman's excellent description and figures and comparing them with those of specimens of *Mesoplodon mirus*, it seems to me that *M. pacificus* should not be considered a distinct species.

Longman says: "The chief characters of the new species [*Mesoplodon pacificus*] are as follows: (1) A single pair of apical mandibular teeth; (2) symphysis more than one-fourth of the mandibular length; (3) no basirostral groove; (4) rostrum very elongated, shallow, margined with a prominent flange; (5) maxillary ridges prominent and not diverging outwards; (6) maxillary foramina much enlarged; (7) no inner notches present in antorbital region; (8) lachrymal very strongly developed and forming the chief lateral constituent of the antorbital tubercle; (9) region of vertex contracted toward the occipital elements, which are almost vertical; (10) transverse diameter behind premaxillae much exceeding antero-posterior length of vertex; (11) nasals confined to anterior moiety of vertex."

Of the eleven characters given in the paragraph cited from Longman, most of them are also characteristic of *Mesoplodon mirus*, as can be seen from a comparison of the published accounts and the specimen figured herein. Again referring to these characters:

(1) The apical mandibular teeth are common to all specimens of *mirus*.

(2) "Symphysis more than one-fourth the mandibular length." In the type of *M. mirus* the symphysis is 28.8 per cent of the length of the mandible; in the Liscannor 1917 specimen, 28.5 per cent, in the Edgemere, L. I., specimen, 30.4 per cent, and in the Queensland specimen of *pacificus*, 28.1 per cent; thus they all fall within very narrow limits and in all the symphysis is slightly more than one-fourth the mandibular length.

(3) "No basirostral groove." This, which is homologous with the caudal portion of the maxillary alveolar groove, is also lacking in all specimens of *mirus* and several other species. This lack of the proximal part of the alveolar groove may well be a specialization away from the more primitive condition of *M. grayi*, in which the groove is well developed and numerous peg-like teeth that were developed in it are to be found.

(4) "Rostrum very elongated, shallow and margined, with a prominent flange." Measurements show approximately the same percentages of depth to width of the rostrum in *mirus*.

(5) "Maxillary ridges prominent and not diverging outwards." *M. mirus* is the same, though most of the photographs of specimens (due to direct lighting) fail to show this character (see Fig. 9 herein).

(6) "Maxillary foramina much enlarged." Some specimens of *mirus* have approximately as large foramina (see Fig. 9).

(7) "No inner notches present in antorbital region." This is possibly an age character, judging by a comparison of figures of the type, the specimen figured by Harmer, 1924, Pl. I, and Longman, 1926, Pl. XLIII, fig. 1. It appears that the inner notch is eliminated with advancing age.

(8) "Lachrymal very strongly developed and forming the chief lateral constituent of the antorbital tubercle." Though the lachrymal forms the apex of the antorbital

tubercle in our specimen, which appears to agree with the type and the specimen figured by Harmer, 1924, it differs markedly from that of *pacificus*.

(9) "Region of vertex contracted toward the occipital elements, which are almost vertical."

(10) "Transverse diameter behind premaxillae much exceeding anteroposterior length of vertex."

(11) "Nasals confined to anterior moiety of vertex."

TABLE IV.—Dimensions of skulls of specimens of *M. mirus* and *M. mirus pacificus*.

	Type ♀ U.S.N.M.	90053 ♀ A.M.N.H.	Liscan- nor ♂ Brit. Mus.	Galway ? ♀ Galway Mus.	<i>M. mirus pacificus</i> ? Q'ns'l'd Mus.
1.—Total length	810	820	814	762 est.	1186
2.—Height, vertex to inf. border of pterygoids	301	307	315	273	455
3.—Width at center of orbits	325	332	337	...	....
4.—Width across zygomatic prs.	345	344	356	330	520
5.—Width across occ. condyles	125	113	117	...	160
6.—Rostrum, length from level of bases of ant. orb. notches	496	510	520	485 est.	815
7.—Rostrum, width between bases of ant. orb. notches	210	213	200	...	335
8.—Rostrum, width at middle	60	65	67	...	160
9.—Breadth of expanded proximal ends of premaxillae	142	147	165	150	241
10.—Least breadth of premaxillae opposite ant. nares	118	115	120	...	....
11.—Breadth of premaxillae opposite pmx. foramina	68	77	75	...	....
12.—Greatest breadth of anterior nares	56	60	59	...	89
13.—Least distance between max. foramina	92	102	91	...	....
14.—Distance from post. border of max. foramen and end of max. protuberance	63	65	61	...	....
15.—Length of portion of vomer visible on palate	162	148	135	...	....
16.—Length of mandible	668	690	700	610	1085
17.—Length of symphysis	193	210	190	152	300
18.—Greatest height of mandible at coronoid process	117	117	122	114	187

These, too, seem to be age characters, a decrease of anteroposterior diameter of the vertex and coalescence of the elements apparently going with increased age and large size. A comparison of figures of specimens of different ages tends to bear this out.

As Longman has pointed out, the specimen from Queensland is the longest skull of all known specimens of the genus. However, it does not exceed the other skulls by a greater percentage of length than do the skulls of males exceed those of females in some other mammals; but in some, but not all, odontocetes of which I have been able to find reliable comparative measurements, the females are larger than the males; consequently as the type of *mirus* is apparently an adult female, I believe that Longman's beaked whale is possibly a Pacific race of *mirus*, its general skull and mandibular characters agreeing with *M. mirus*; but it differs in its much larger size and in the conformation of the lachrymal and the nasals. Consequently in the following pages I am considering *pacificus* as a variety of *M. mirus*.

TABLE V.—Key to the species of *Mesoplodon* based on skull and mandibular characters.

- 1.—Lateral basirostral groove present.....2.
 Lateral basirostral groove absent.....4.
- 2.—Lateral basirostral groove deep and conspicuous.....*grayi*.
 Lateral basirostral groove shallow and inconspicuous.....3.
- 3.—Vertical height of rostrum greater than its width (measured at a point halfway between antorbital notch and tip of rostrum).
 Maxillary foramina rostral to premaxillary foramina.....*densirostris*.
 Vertical height of rostrum less than its width.
 Maxillary foramina caudal to premaxillary foramina.....*layardii*.
- 4.—Premaxillary foramina markedly rostral to maxillary foramina.....5.
 Premaxillary foramina caudal to or in line with max. foramina.....6.
- 5.—Tooth compressed, situated caudal to symphysis.....*bidens*.
 Tooth compressed, situated opposite symphysis.....*europaeus*.
- 6.—Tooth not compressed, situated at or near tip of mandible.....7.
 Tooth compressed, situated caudal to symphysis.....9.
- 7.—Distance from occipital condyle to premaxillary foramen about equal to greatest width of skull; mental foramen multiple.....*hectori*.
 Distance from occipital condyle to premaxillary foramen much less than greatest width of skull; mental foramen single.....8.
- 8.—Total length of skull of adult under one meter, inhabits Atlantic...*mirus mirus*.
 Total length of skull of adult over one meter, inhabits Pacific...*mirus pacificus*.
- 9.—Maxillary protuberance and ridge very pronounced.....*bowdoini*.
 Maxillary protuberance and ridge scarcely distinguishable.....*Stejnegeri*.

VERTEBRÆ.—The vertebral column (Fig. 15) is in general very much like that of *M. europæus*. The vertebral formula is C. 7; T. 10; L. 11; Ca. 18 = 46. The first three cervicals are fused. The first seven ribs are attached by both head and tubercle. The three posterior ribs are attached to the transverse processes only. The first five ribs have cartilaginous attachments to the sternum. There are nine well-developed chevrons beneath the proximal caudals and, more caudally, nine intercentral spaces without chevrons.

STERNUM.—The sternum (Fig. 6B) is composed of four sternebræ more rectangular in outline than those of *M. europæus* and with smaller intersternebral fontanelles. Harmer (1924, p. 574) gives in a table the dimensions of various parts of the sternum in two specimens of *M. mirus*. I here add to his table the measurements of the present specimen.

TABLE VI.—Measurements of the parts of the sternum in three specimens of *M. mirus*.

	Total leng	S ¹ length	S ¹ width	S ² length	S ² width	S ³ length	S ³ width	S ⁴ length	S ⁴ width	F ¹ length	F ² length	F ³ length	F ⁴ length
SPECIMEN													
Liscannor	633	254	172	144	140	128	136	135	123	10	15	22	12
Galway	437	197	141	95	106	76	106	95	80	34	38	19	14
Long Island	450	192	150	110	100	90	97	68	78	28	35	12	8

The measurements show that the various parts of the sternum undergo considerable variation in proportions, much of which may be due to age. A comparison of the specimen figured by Harmer (Pl. IV, fig. 7) and the present specimen, however, shows a close similarity.

FORE LIMB.—(Fig. 7B) The scapula is wider than high, with its vertebral border evenly rounded. The supraspinous fossa appears even smaller than in *M. europæus*. The acromial process is wide and long and stands out much more from the rostral border of the scapula than it does in *M. europæus*.

The preaxial border of the radius is slightly convex in *mirus*, whereas in *europæus* it is concave.

The olecranon process of the ulna is not nearly so large in *M. mirus* as in *europæus*, but in this specimen has a larger cartilage, which if ossified would make them about equal.



Fig 15 *Mesoplotodon mus*, stranded at Edgemere, Long Island, January 14, 1934, and (below) mounted skeleton of the same individual

There are five well-developed carpal elements in *mirus*. The cuneiform of the proximal row is coalesced with the unciform of the distal row and as in *M. europaeus* the magnum is coalesced with the trapezoid and the trapezium with the metacarpal of the first digit.

The phalangeal formula is I 2; II 4; III 4; IV 3; V 2.

LITERATURE CITED

- ALLEN, GLOVER M. 1906. 'Sowerby's whale on the American coast.' Amer. Nat., XL, p. 359.
- ANDERSON, JOHN. 1878. 'Anatomical and zoölogical researches comprising an account of the zoölogical results of the two expeditions to Western Yunnan in 1868 and 1875 and a monograph of the two cetacean genera, *Platanista* and *Orcella*.' 2 vols., text and plates. London, Bernard Quaritch. [See Pl. xli, fig. 14, bones of the left forearm and manus of *Platanista gangetica*.]
- ANDERSON, R. J. 1901. 'A note on a beaked whale.' Irish Naturalist, X, pp. 117-119.
- ANDREWS, ROY C. 1908a. 'Description of a new species of *Mesoplodon* from Canterbury Province, New Zealand.' Bull. Amer. Mus. Nat. Hist., XXIV, Art. 13, pp. 203-215.
- 1908b. 'Notes upon the external and internal anatomy of *Balaena glacialis* Bonn.' Bull. Amer. Mus. Nat. Hist., XXIV, Art. 10, pp. 171-182.
1914. 'Notice of a rare ziphioid whale, *Mesoplodon densirostris*, on the New Jersey coast.' Proc. Acad. Nat. Sci. Phila., LXVI, pp. 437-440, Pls. xvi, xviii.
- ANTHONY, R., AND COUPIN, F. 1930. 'Recherches anatomiques sur le vestibule de l'appareil respiratoire (poche gutturale-hyoïde-larynx) du *Mesoplodon*.' Mem. d. Inst. Espanol de Oceanografia, XIV, pp. 1-40.
- BRASIL, L. 1909. 'Les cétacés du Musée d'Histoire naturelle de Caen.' Bull. Soc. Linn. Normandie, (6) I, (1907), pp. 157-261. [Pls. i, ii, skull; 2 text figs., tooth.]
- BROOM, R. 1927. 'Some further points on the structure of the mammalian basi-cranial axis.' Proc. Zool. Soc. London, April 6, 1927, part 1, pp. 233-244.
- FLOWER, W. H. 1876. 'Remarks upon Dr. von Haast's communication on *Ziphius novaezealandiae*.' Proc. Zool. Soc. London, pp. 477-486.
1878. 'A further contribution to the knowledge of the existing ziphioid whales: genus *Mesoplodon*.' Trans. Zool. Soc. London, X, part 11, pp. 415-437.
1885. 'An introduction to the osteology of the Mammalia.' Third Ed. London. Macmillan and Co. 382 pp.
- FRASER, F. C. 1934. 'Report on Cetacea stranded on the British coasts from 1927-1932.' British Museum (Natural History). Printed by Order of the Trustees. No. 11. [*Mesoplodon bidens*, Fig. 8.]
- GERVAIS, PAUL. 1848-1852. 'Zoologie et paléontologie françaises. Nouvelles recherches sur les animaux vertébrés dont on trouve les ossements

- enfouis dans le sol de la France. . . ' 2 vols., text and plates. Paris, Arthus Bertrand. 544 pp. Second Edition, 1859.
- 1854-1855. 'Histoire naturelle des mammifères.' Vol. II. Paris, L. Curmer. [*Mesoplodon*, pp. 320, 321.]
- GRAY, J. E. 1865. 'Notes on the whales of the Cape; by E. L. Layard, Esq., of Capetown, Corr. Memb. With descriptions of two new species.' Proc. Zool. Soc. London, 1865, pp. 357-358.
- GREGORY, WILLIAM K. 1910. 'The orders of mammals.' Bull. Amer. Mus. Nat. Hist., XXVII, Feb., 1910, pp. 1-524.
1920. 'Studies in comparative myology and osteology, No. IV. A review of the evolution of the lacrymal bone of vertebrates with special reference to that of mammals.' Bull. Amer. Mus. Nat. Hist., XLII, Art. 2, pp. 95-263.
- GRIEG, JAMES A. 1904. 'Bidrag til kjendskaben om *Mesoplodon bidens*, Sow.' Bergens Mus. Aarbog. 1904. Afhandlinger og Aarsberetning, pp. 1-39.
- HAAST, JULIUS VON. 1876a. 'Notes on the skeleton of *Ziphius novae-zealandiae*.' Proc. Zool. Soc. London, pp. 466-477.
- 1876b. 'Notes on *Mesoplodon floweri*.' Trans. and Proc. New Zealand Inst., pp. 442-450.
- 1876c. 'On *Oulodon*; a new genus of ziphioid whales.' Trans. and Proc. New Zealand Inst., IX, pp. 450-457.
- HALE, HERBERT M. 1931a. 'Beaked whales—*Hyperoodon planifrons* and *Mesoplodon layardii*—from South Australia.' Rec. S. Austr. Mus., IV (1928-1932), pp. 291-311.
- 1931b. 'The goose-beaked whale (*Ziphius cavirostris*) in New Ireland.' Rec. S. Austr. Mus., IV (1928-1932), pp. 312, 313.
- 1931c. 'The pigmy right whale (*Neobalaena marginata*) in South Australian waters.' Rec. S. Austr. Mus., IV (1928-1932), pp. 314-319.
- HARMER, S. F. 1914-1927. 'Report on Cetacea stranded on the British coasts during 1913-1926. Reports 1-10.' Mem. Brit. Mus. (Nat. Hist.). Printed by Order of the Trustees of the British Museum.
1924. 'On *Mesoplodon* and other beaked whales.' Proc. Zool. Soc. London, part 2, pp. 541-587.
- HINTON, MARTIN A. C. 1925. 'Reports on papers left by the late Major G. E. H. Barrett-Hamilton relating to the whales of South Georgia.' Publ. by the Crown Agents for the Colonies. London.
- IREDALE, TOM, AND TROUGHTON, E. LEG. 1934. 'A check-list of the mammals recorded from Australia.' Austr. Mus., Sydney, Mem. VI. [Family Hyperoodontidae, pp. 60-62.]
- KELLOGG, REMINGTON. 1928. 'The history of whales—their adaptation to life in the water.' Part I, Quart. Rev. Biol., III, No. 1, March, pp. 29-76. Part II, Quart. Rev. Biol., III, No. 2, June, pp. 174-208.
- LONGMAN, HEBER A. 1926. 'New records of Cetacea, with a list of Queensland species.' Mem. Queensland Mus., VIII, pp. 266-278.
- LYDEKKER, R. 1911. 'A rare beaked whale.' Proc. Zool. Soc. London, 1911, pp. 420-422.

- OLIVER, W. R. B. 1922. 'A review of the Cetacea of the New Zealand seas.' I. Proc. Zool. Soc. London, pp. 557-585.
- PYCRAFT, W. P. 1935. 'President's Address.' Trans. Norfolk and Norwich Nat. Soc., XIV, part I, pp. 1-30.
- RAVEN, H. C., AND GREGORY, WILLIAM K. 1933. 'The spermaceti organ and nasal passages of the sperm whale (*Physeter catodon*) and other odontocetes.' Amer. Mus. Novitates, No. 677, 18 pp.
- SCHULTE, H. VON W. 1916. 'Anatomy of a foetus of *Balaenoptera borealis*.' Mem. Amer. Mus. Nat. Hist., (N.S.) I, part 6, pp. 389-502.
- STEPHEN, A. C. 1931. 'True's beaked whale (*Mesoplodon mirus*) new to the Scottish fauna.' Scottish Naturalist, No. 187, January-February, pp. 37-39.
- TRUE, FREDERICK W. 1910. 'An account of the beaked whales of the Family Ziphiidae in the collection of the United States National Museum, with remarks on some specimens in other American museums.' Bull. U. S. Nat. Mus., LXXIII, pp. 1-89.
1913. 'Description of *Mesoplodon mirum*, a beaked whale recently discovered on the coast of North Carolina.' Proc. U. S. Nat. Mus., XLV, No. 2007, pp. 651-657.
- VAN BENEDEN, P. S., AND GERVAIS, PAUL. 1880. 'Ostéographie des Cétacés, vivants et fossiles....' I. Text. II. Plates. Paris, Arthus Bertrand. 4to. 634 pp.
- VROLIK, W. 1848. 'Natuur- en Ontleedkundige Beschouwing van den *Hyperoodon*.' Natuurkundige Verhand. van de Hollandsche Maatsch. d. Wetensch. te Haarlem, V, part 1, pp. 1-128.

AMERICAN MUSEUM NOVITATES

Number 906

Published by
THE AMERICAN MUSEUM OF NATURAL HISTORY
New York City

January 16, 1937

NEW HESPERIIDAE FROM THE ANTILLES (LEPIDOPTERA. RHOPALOCERA)

By FRANK E. WATSON

In the course of working up the West Indian material in the Museum collection a few apparently new forms were discovered. As it will probably be some time before the complete reports are published, these new names are proposed at this time.

Wallengrenia otho mutchleri, new subspecies

Differs from the nymtotypical *otho* (Smith and Abbot) as follows.

MALE.—Upper side of primaries, spots and markings bright orange-tawny, this color well developed along costa, at base and inner margin. The costal band extends from the base to the subapical spots, usually obliterating one or two of them. The maculation in typical *otho* is much duller, and less well developed along costa, at base and along inner margin. The costal band, in *otho*, often does not reach the subapical spots and, when it does, it is as a thin streak along the costa. The round black spot of the stigma in *mutchleri* is reduced to a point or is obsolete. Beyond the stigma, in *otho*, is a quadrate patch of blackish-gray scales; in the Puerto Rican race this patch is bifid and extends slightly farther distad. Fringe, orange, brownish apically.

Secondaries, above, heavily overlaid with fulvous hairs and scales, so that the entire wings appear nearly fulvous except for a narrow marginal line, and a narrow area below the costa. In *otho* this overlaying is of dull tawny and is confined to the discal area, sometimes presenting a few more or less obscure discal spots. Fringes orange.

Primaries, below, differing from *otho* in the greater amount of dark fulvous.

Secondaries greenish fulvous with the discal spots obsolete. In *otho* these spots are more distinct and the greenish tint is entirely wanting.

FEMALE.—Above, showing about the same differences as the male. The fulvous markings are reduced and duller and the spots paler.

Underside, likewise showing about the same differences as the male but the discal spots are usually present.

Expanse, somewhat less than that of *otho*.

TYPES.—Holotype, male, Aibonito, Puerto Rico, July 14–17, 1914 (author); allotype, female, Aibonito, Puerto Rico, July 14–17, 1914 (author). Paratypes, twenty-two males and eleven females from the following localities in Puerto Rico. Males: one, San Juan, July 9–12, 1914 (author); one, Manatí, March 5, 1914 (Lutz); one, Arecibo, July 30–Aug. 1, 1914 (author); five, Mayagüez, July 24–29, 1914 (author); two, Adjuntas, June 8–13, and 26, 1915 (Lutz and Mutchler); one,

Barros, June 4, 1915 (Lutz and Mutchler); ten, Aibonito, July 14-17, 1914 (author); one, Cayey, May 30-31, 1915 (Lutz and Mutchler). Females: one, San Juan, July 9-12, 1914 (author); one, Arecibo, July 30-Aug. 1, 1914 (author); Adjuntas, two, June 8-13, and one, June 26, 1915 (Lutz and Mutchler); five, Aibonito, July 14-17, 1914 (author); one, Aibonito, June 1-3, 1915 (Lutz and Mutchler).

Types in the collection of The American Museum of Natural History.

I take pleasure in dedicating this subspecies to Mr. A. J. Mutchler of this Museum, who collected many Lepidoptera in Puerto Rico.

HABITAT.—Puerto Rico, Mona and Desecheo Islands; St. Thomas and St. Croix, Virgin Islands; Hispaniola.

SPECIMENS COLLECTED.—In addition to the types, listed above, there are ninety-seven specimens from Puerto Rico and two from the Virgin Islands, males and females, that owing to their condition are not included in the type series. Puerto Rico: San Juan, Cantafío, Manatí, Arecibo, Mayagüez, Maricao, Adjuntas, Barros, Tallaboa, Coamo Springs, Aibonito, Cayey, Caguas, Naguabo, Luquillo National Forest, Mona Island and Desecheo Island, collected by Lutz, Mutchler, Crampton and author between dates of Feb. 11 and 26, March 1 and 9, July 9 and Aug. 1, Dec. 26-29, 1914; May 28 and June 29, 1915; Aug. 13 and 22, 1919; Feb. 17 and 20, 1925. Virgin Islands: one, Charlotte Amalie, St. Thomas, June 2, 1911 (Crampton); one, St. Croix, March 2, 1925 (Lutz).

RECORDS.—Charlotte Amalie, St. Thomas, Virgin Islands, March 14, 1929 (Brown, Huntington), and April 13, 1929 (Huntington).

REMARKS.—Williams and Bell, 1934, Trans. Amer. Ent. Soc., LX, p. 279, show that *Wallengrenia* Berg has priority over *Catia* Godman.

A series of specimens in the Museum collection from Hispaniola agree very closely with those from Puerto Rico and the Virgin Islands. I refer them to the race described above as new.

Skinner and Williams, 1924, Trans. Amer. Ent. Soc., L, p. 156, state that *drury* (Latreille) is from the Antilles. I am unable to find any reference to the Antilles in Latreille's original description but he states: "Cette espèce est très-voisine de l'*H. Thaumus*, & habite les mêmes contrées." The species referred to, *thauumas* (Fabricius) [= *cernes* (Boisduval and Le Conte)], is a common species of the eastern United States and Canada. Riley, 1926, Trans. Ent. Soc. London, LXXIV, p. 239, in his paper 'On The Identity of Certain Hesperidae Described by Latreille,' considers *otho* (Smith and Abbot) and *drury* (Latreille) as synonymous. Godman, 1900, 'Biol. Centr.-Amer.,' Rhopal., II, p.

482, considers *drury* (Latreille), *pustula* (Geyer), *otho* (Boisduval and Le Conte) (not Smith and Abbot) and *aetna* (Scudder) as synonymous, and also includes *egeremet* (Scudder). We have specimens in the Museum collection from Georgia that agree very well with Latreille's description, and with the figures of Geyer, and Boisduval and Le Conte. I do not believe, however, that such intermediate specimens are worthy of a separate name. The synonymy of the nymotypical *otho* is given below.

1797. *Papilio otho* SMITH AND ABBOT, 'Lep. Ins. Ga.,' I, p. 31, Pl. xvi.

1823. *Hesperia drury* LATREILLE, 'Enc. Méth.,' IX, p. 767.

1832. *Thymelicus pustula* GEYER, in Hübner's 'Zutr. exot. Schmett.,' IV, p. 11, Figs. 625-626.

1833. *Hesperia otho* BOISDUVAL AND LE CONTE, 'Lép. Amér. Sept.,' I, Pl. LXXXVII.

1872. *Hedone aetna* SCUDDER, 4th Ann. Rep. Peabody Acad. Sci., p. 97.

1924. *Catia otho* SMITH AND ABBOT—DRAUDT, in Seitz's 'Macrolep.,' V, p. 933, p. 1054, Pl. CLXXXI, e.

DISTRIBUTION.—Southern and Gulf States to Mexico, Central America to Brazil. Specimens from the northeastern United States and southern Canada, and west to the Rocky Mountains, may be referred to the race *egeremet* (Scudder). The synonymy is:

1863. *Hesperia egeremet* SCUDDER, Proc. Ess. Ins., III, p. 174.

1880. *Pamphila ursa* WORTHINGTON, Can. Ent., XII, p. 49.

1883. *Hesperia cinna* PLÖTZ, Ent. Zeit., XLIV, p. 58.

The darkest race of *otho* is *misera* (Lucas), with only mere traces of fulvous on the wings. It occurs in Cuba, Isle of Pines and Bahamas. The synonymy is:

1857. *Hesperia misera* LUCAS, in Sagra's 'Hist. Cuba,' VII, p. 207.

1863. *Pamphila mago* HERRICH-SCHAEFFER, Corresp. Blatt., XVII, p. 142.

The smallest and brightest of the *otho* races is *vesuria* (Plötz), from Jamaica. It is very distinct, but it has been erroneously referred to Cuba and Hispaniola. The original reference is:

1883. *Hesperia vesuria* PLÖTZ, Ent. Zeit., XLIV, p. 63.

It seems quite remarkable that the species *otho*, with its extremely wide distribution, should apparently be replaced in the Lesser Antilles by the very distinct and beautiful species *ophites* Mabille [= *ravola* (Godman and Salvin)]. The Museum collection contains specimens from St. Kitts, Dominica, Martinique and St. Lucia.

Several names have been proposed for species from Central and South America, one or more of which may prove to be races of *otho*.

Panoquina nero belli, new subspecies

MALE.—Ground color of all wings above dark brown, lightly overlaid basally with fulvous hairs. Primaries with the usual seven or eight hyaline spots. Fringes concolorous, lighter below Cu_2 . Secondaries above, immaculate except for a barely perceptible trace of a narrow transverse band of diffuse scales, lighter than the ground color, and representing the band or stripe on the underside. Fringes whitish, basally light brown, concolorous at apex. Primaries below, the same as on the upper side but paler, blackish basally. Fringes concolorous, lighter below Cu_2 . Secondaries below, brown, paler than on upper side, with a conspicuous post-discal white stripe, which commences before the apex and extends from $Sc + R$, to the fold below Cu_2 . This stripe, consisting of contiguous quadrate white spots, shows a tendency to interruption at the veins, these being covered with pale yellow scales, at the stripe, and with white or whitish scales at Cu_2 . Fringes whitish, basally fuscous, darker at apex.

FEMALE.—Above, nearly identical with male but having the ground color slightly darker. Below, nearly identical with male, but the ground color is rich brown, with a slight violet reflection, most noticeable at apex of primaries and outer margin of secondaries.

Head and thorax above greenish. Abdomen above dark brown, basally somewhat greenish. Palpi, second joint densely clothed with long pale yellowish, mixed with brownish scales, bright yellow before the eyes; third joint dark brown. Thorax below whitish. Abdomen below yellowish white with a ventral and lateral brown line. Legs fulvous above, whitish below. Antennae dark brown, their clubs below with basal half yellowish, this yellow scaling extending down the shaft; distal half of club and apiculus reddish.

Expanse of holotype male, 40.3 mm.; length of primary, 21.2 mm.

Expanse of allotype female, 44.4 mm.; length of primary, 24.4 mm.

TYPES.—Holotype, male, Aibonito, Puerto Rico, July 14–17, 1914 (author); allotype, female, Aibonito, Puerto Rico, July 14–17, 1914 (author). Paratypes, eight males and three females, from the following localities in Puerto Rico. Males: one, Adjuntas, June 8–13, 1915 (Lutz and Mutchler); one, Aibonito, July 14–17, 1914 (author); three, Naguabo, March 7–9, 1914 (Lutz); one, San Juan, Feb. 10, 1927 (Fraser); two, Dorado, March 26, 1930 (Forbes), collection Cornell University. Females: one, Ensenada, June 14–19, 1915 (Lutz and Mutchler); one, Tallaboa, June 23, 1914 (author); one, Dorado, March 26, 1930 (Forbes), collection Cornell University.

Types in the collection of The American Museum of Natural History except the three mentioned above in the collection of the Cornell University.

I take great pleasure in dedicating this subspecies to my friend Mr. E. L. Bell, and take this opportunity of expressing appreciation for his assistance.

HABITAT.—Puerto Rico.

RECORDS.—One, Adjuntas, P.R., June 9, 1915 (Gerould).

REMARKS.—Butler, in his 'Catalogue of Diurnal Lepidoptera Described by Fabricius,' 1869, p. 275, lists under *Epargyreus nero* a specimen from Santo Domingo, which he considered to be the *nero* of Fabricius.¹ He figures this specimen on Pl. II, fig. 13. As Butler's figure agrees quite well with the original description and with specimens from Haiti in the Museum collection, I follow Skinner and Williams² in considering it as typical of *nero* (Fabricius). Should this species occur in St. Thomas, it may be that specimens from that island will agree better with the original description than do those from Hispaniola.

The Museum collection contains five specimens of the nymotypical race *nero* (Fabricius) from Haiti, which differ from the Porto Rican specimens, race *belli*, as follows. Ground color of upper side of all wings, a shade lighter brown, with a hint of gray in it. On the underside the ground color is gray-brown, distinctly grayer than in the Puerto Rican race. The stripe on the underside of the hind wings averages narrower than in race *belli*. In three individuals, this stripe agrees quite well with Butler's figure, and in one of these it is distinctly interrupted, exactly agreeing with the Fabrician description, "striga interrupta alba." The male genitalia of these two subspecies are nearly identical.

Type locality of *P. nero* (Fabricius).—West Indies.

Distribution of *P. nero nero* (Fabricius).—Hispaniola and ? St. Thomas, Virgin Islands. References to main land localities, it would seem, belong to other species.

A name appearing in the synonymy of West Indian *Panoguina* Hemming (*Prenes* Scudder) is *fufidia* (Hewitson).³ This was described from a specimen in the Staudinger collection, which probably came from a mainland locality. The Museum collections contain a single male from Mexico, which agrees closely with Draudt's⁴ figure of *nero*, is "rufous-brown" beneath, and the white band on the underside of the secondaries begins with a "separate spot." I tentatively place Draudt's figure and the Mexican specimen as *fufidia* (Hewitson). The insect is more extensively overlaid with fulvous hairs on the upper side of the wings and the white band on the underside of the secondaries is subparallel with the outer margin, both of which characters are shown in Draudt's figure, while in both races of *nero* it is transverse. The genitalia of the Mexican specimen are of the same type as those of *nero* but show good

¹ 1798, *Hesperia nero* Fabricius, 'Ent. Syst.,' Suppl., p. 433.

² 1923, Trans. Amer. Ent. Soc., XLIX, p. 150.

³ 1877, *Hesperia fufidia* Hewitson, Ann. and Mag., XIX (45), p. 81.

⁴ 1924, *Prenes nero* Draudt (not Fabricius), in Seitz's 'Macrolep.,' V, p. 948, Pl. CLXXXIII, h

specific differences. I have no doubt as to its being a distinct species.

Godman,¹ Pl. xcvi, fig. 7, figures a specimen from Chiriqui, as *Prenes nero* var. *corrupta* (Herrich-Schaeffer).² The Cuban insect, *corrupta*, has a differently shaped transverse band and not one parallel with the outer margin as shown in the Godman figure. I believe this figure represents a distinct species but do not know what name may apply to it. Draudt, 1924, in Seitz's 'Macrolep.,' V, Pl. clxxxiii, h, gives a good figure of *corrupta*. The latter hesperiid is so abundantly distinct from *nero* (Fabricius) that, even though their genitalia are very close, I have no hesitancy in considering them distinct species.

***Panoquina sylvicola woodruffi*, new subspecies**

Males and females of the same size and shape as the Cuban *sylvicola* (Herrich-Schaeffer), and with the hyaline spots identical. Ground color of all wings of both sexes, above and below, distinctly lighter.

MALE.—Secondaries below with the spots whitish, rarely slightly tinted with blue, not distinctly greenish blue as in most Cuban specimens.

FEMALE.—Primaries below without the violaceous apical patch. Secondaries below with the spots whitish and lacking the greenish-violet area so distinct in *sylvicola*. An occasional female with the spots slightly bluish, and one specimen in our series with a very slight indication of the bluish area.

TYPES.—Holotype, male, Aibonito, Puerto Rico, July 14–17, 1914 (author); allotype, female, Naguabo, Puerto Rico, Jan. 19, 1914 (Crampton). Paratypes, eleven males and five females from the following localities in Puerto Rico and the Virgin Islands. Males: one, San Juan, Feb. 11–14, 1914 (Lutz) and three, July 9–12, 1914 (author); two, Coamo Springs, Dec. 26–29 (Crampton) and one, July 17–19, 1914 (author); one, Aibonito, July 14–17, 1914 (author); one, Barros, June 4, 1915 (Lutz and Mutchler); two, Charlotte Amalie, St. Thomas, Virgin Islands, Nov. 20, 1920 (Forbes), collection Cornell University. Females: two, San Juan, Feb. 11–14, 1914 (Lutz); one, Santurce, Jan. 8, 1914 (Crampton); one, Cayey, May 30–31, 1915 (Lutz and Mutchler); one, St. Thomas, Virgin Islands, Feb. 25, 1925 (Lutz).

Types in the collection of The American Museum of Natural History, with the exception of the two mentioned above in the collection of the Cornell University.

I take pleasure in dedicating this subspecies to Mr. L. B. Woodruff, who collected a number of Lepidoptera in Porto Rico.

HABITAT.—Puerto Rico; St. Thomas, St. John, Tortola, St. Croix, Virgin Islands; Hispaniola.

¹ 1900, 'Biol. Centr.-Amer.,' Rhopal., II, p. 509.

² 1865, *Gonoloba corrupta* Herrich-Schaeffer, Corresp.-Blatt., XIX, p. 54.

SPECIMENS COLLECTED.—In addition to the types, listed above, there are fifty-nine specimens from the following localities in Puerto Rico and the Virgin Islands, males and females, that owing to their condition are not included in the type series: San Juan, Cantañó, Santurce, Manatí, Arecibo, Mayagüez, Quebradillos, Guayanilla, Adjuntas, Coamo Springs, Cayey, Aibonito, Barros, Caguas, Luquillo National Forest; St. Thomas, St. John, Tortola, St. Croix, Virgin Islands. The dates of capture are from Jan. 1 to July 27 and Dec. 26–29. A very common species probably occurring everywhere on the island of Puerto Rico and flying throughout the year.

RECORDS.—Guanica, Puerto Rico (Gerould); Rio Piedras, P.R., Feb. 11, 1927 (Fraser); Toa Baja, P.R., Jan. 31, 1915 (Garb), collection Cornell University.

REMARKS.—The nymotypical race *Panoquina sylvicola sylvicola* (Herrich-Schaeffer) was described from Cuba. Its synonymy is as follows:

- 1865. *Goniloba sylvicola* HERRICH-SCHAEFFER, Corresp.-Blatt., XIX, p. 55.
- 1868. *Hesperia fusina* HEWITSON, 'Desc. Hesp.', p. 30.
- 1883. *Hesperia neriena* PLÖTZ, Ent. Zeit., XLIV, p. 43.
- 1900. *Prenes nero* GODMAN (not Fabricius), 'Biol. Cent.-Amer.,' Rhopal., II, p. 509 Pl., xcvi, figs. 4–6.
- 1923. *Prenes sylvicola* HERRICH-SCHAEFFER—SKINNER AND WILLIAMS, Trans. Amer. Ent. Soc., XLIX, p. 150, Fig. 41 (male genitalia).
- 1924. *Prenes nero sylvicola* HERRICH-SCHAEFFER—DRAUDT, in Seitz's 'Macrolep.,' V, p. 948, Pl. CLXXXIII, i.
- 1935. *Prenes nero sylvicola* HERRICH-SCHAEFFER—M. BATES, Bull. Mus. Comp. Zool., LXXVIII, No. 2, p. 229.

Hewitson described *fusina* from "Amazon (Santarem)." Specimens in the Museum collection from Brazil and other parts of the mainland seem very close to *sylvicola*. If it is desirable to have a mainland race *fusina* Hewitson would be available.

Jamaican specimens are much closer to those from Cuba than they are to those from Puerto Rico and the Virgin Islands but they are here placed as *sylvicola*.

Material from Hispaniola, if not identical with, is very close to that from Puerto Rico and is here placed as *woodruffi*.

The Museum collection also contains specimens from St. Kitts, Antigua, Guadeloupe and Dominica. These match quite closely those from Jamaica, and are here, at least for the present, considered together with specimens recorded from the other islands, listed below, as belonging to the race *sylvicola*.

Distribution of *P. s. sylvicola* (Herrich-Schaeffer).—Cuba, Isle of Pines, Grand Cayman, Jamaica, St. Kitts (Brown and Huntington), Antigua, Guadeloupe (Brown and Huntington), Dominica, Martinique, St. Vincent, Grenada; Florida, Mexico, Central and South America to Brazil.

This common neotropical hesperiid is the *Prenes nero* of various authors. *P. nero fufidia* Draudt (not Hewitson), *op. cit.*, is apparently the same as the race occurring in Puerto Rico, to which I have applied the name *woodruffi*. His figure, Pl. CLXXXIII, i, agrees quite well with specimens from Puerto Rico, but the average specimen from the island has the spots on the hind wing below somewhat more punctiform.

The genitalia of *sylvicola* and *woodruffi* are identical.

Rhinthon bushi, new species

MALE.—Upper side of all wings dark brown. Primaries with three pale yellow subapical spots, the upper being elongate and the second very small. The primaries have also four large more or less quadrate semi-hyaline yellowish-white spots situated as follows: a subquadrate spot extends nearly across the cell at about 3/4 from base to end of cell; a second quadrate spot, the smallest of the series, between veins M_2 and Cu_1 ; a third, subquadrate and the largest, between Cu_1 and Cu_2 ; the fourth spot lies on A_2 and is wider than high. Spots 2 to 4 form a postdiscal series. The primaries have an overlaying of dark fulvous hairs and scales in the basal area. Fringes dark brown, orange at anal angle. Secondaries, immaculate, with reddish-brown hairs in the basal area. Fringes as in primaries.

Underside of all wings a paler and warmer brown. Costal and costo-apical areas dark fulvous. Basal area blackish. Inner marginal area fuscous. A large apical patch of diffused greenish-yellow scales, those before the apex being whitish. The spots of the upper side repeated but the third post-discal spot on A_2 is white. The cell spot has above it 3 bright greenish-yellow streaks. A fourth subapical spot of bright greenish-yellow appears above the 3 mentioned followed by a small streak toward the apex and a second above it of the same color. Secondaries with 5 spots. A small nearly round orange spot at base of interspace $Sc + R_1-R_2$. A large irregular white spot in the cell more or less ringed with orange scales distad of which is a second small nearly round orange spot. Below this a silvery-white elliptical spot in the base of interspace Cu_2-A_3 . A larger nearly elliptical spot of silvery-white lies below the one just mentioned. These three large discal spots are contiguous and form a large irregular spot basad of the center of the wing.

Above, the palpi, head and patagia are bright green, shining, mixed with dark fulvous hairs. Tegulae, brown with some greenish hairs. Thorax denuded. Abdomen dark brown. Beneath, palpi bright dark orange with a few bright shining green scales. Thorax and base of abdomen bright green. Remainder of abdomen brown with some dark fulvous hairs. Legs dark fulvous, femures with green hairs. Antennae, above, dark brown, clubs black with a few scattered dark fulvous scales at the base. Below, dark brown, club, orange.

Expanse, 34.4 mm.; length of primary, 18 mm.

HOLOTYPE.—Male, Paradis, San Domingo, West Indies, 1800 ft., Aug. 18, 1932 (Bush), in the collection of The American Museum of Natural History.

Named for my friend Mr. Wm. M. Bush who donated the single specimen captured to this Museum.

A beautiful species unlike any species of *Rhithon* known to me, differing, among other characters, in having large silvery-white spots on the underside of the secondaries.

There is but one other species of *Rhithon* from the West Indies, namely, *R. thermae* Kaye¹ from Jamaica. The species described above as new has an additional post-discal spot on the primaries, on A_2 , and the large silvery-white spots on the underside of the secondaries not found in *thermae*.

*Godmania*² *borincona*, new species

FEMALE.—Upper side of all wings dark brown. Primaries with a yellow transverse discal fascia, divided by the veins into spots, extending from M_2 to A_2 . The spot between Cu_2 and A_2 geminate, the one between Cu_1 and Cu_2 the largest and subquadrate. These spots are dusted over with ferruginous scales, giving the band an orange tint, the first and last spots being somewhat ferruginous. Some ferruginous scales at the base, in the cell, and along inner margin. Subapical streaks ferruginous, more or less obsolete. Fringes nearly concolorous with ground color of wing, paler below Cu_2 .

Hind wings above, immaculate, overlaid with ferruginous hairs and scales, except for the costo-marginal area, and outer and inner margins. Fringes paler than ground color of wings, and with some pale fulvous scales.

Primaries below, similar to upper side, paler, darker at base. Discal band paler, larger, only narrowly cut by the veins. The band, here, stands almost vertical to the inner margin and its outer edge is subparallel with the outer margin. The last spot of the band, largest, not geminate, pale yellow; spots above dusted over with ferruginous, the two upper spots being somewhat ferruginous. Subapical streaks absent. Costal area to and around end of cell, and in distal end of cell, heavily overlaid with ferruginous scales. A dusting of these scales in the apical area. Fringes similar to those on upper side but with some ferruginous scales apically.

Secondaries below, unicolorous dull brown, paler than on upper side, dusted over with ferruginous scales, most pronounced and forming streaks in the interspaces Cu_2 - A_2 and A_2 - A_3 . Fringes similar to those on upper side.

Head and thorax above, green; abdomen above, dark brown; palpi, green. Thorax below, pale greenish. Legs above, ferruginous; below, greenish white. Antenna, blackish; base of club, ferruginous; club below, yellow, this yellow scaling extending down the shaft.

Expanse, 30.7 mm.; length of primary, 16.5 mm.

¹ 1926, Trans. Ent. Soc. London (1925), p. 495.

² 1931, Trans. Ent. Soc. London, p. 536, Pl. XXXIX, fig. 14.

³ *Godmania* Skinner and Ramsden, 1923, Proc. Acad. Nat. Sci. Phila., LXXV, p. 321.

Types.—Holotype, female, Adjuntas, Puerto Rico, June 11, 1915 (Lutz and Mutchler), apparently a fresh specimen when captured. Paratypes, two females, from the following localities in Puerto Rico. San Juan, Feb. 8, 1927 (Fraser) and Dorado, March 26, 1930 (Forbes), collection Cornell University.

The paratypes are larger than the holotype, especially the specimen from San Juan, which is quite robust and has an expanse of 40 mm.

Types in the collection of The American Museum of Natural History, with the exception of the one mentioned above in the collection of Cornell University.

HABITAT.—Porto Rico.

RECORDS.—Two females collected by Krug and recorded without definite locality by Dewitz, 1877, Ent. Zeit., XXXVIII, p. 243, Pl. I, fig. 5.

REMARKS.—This species is superficially close to *G. silius* (Latreille), (*Hesperia*), 1823, 'Enc. Méth.,' IX, p. 764. The Museum collection contains a male specimen from Brazil (Hy. Edwards collection), which agrees closely with the original description, and which I believe to be the *silius* of Latreille. It differs from the Porto Rican insect, besides minor details, in having the transverse band reddish, the head and thorax above brown, palpi and thorax below, fulvous. These parts are green in *borincona*. Although a smaller insect, the specimen from Brazil has longer antennae than the one from Porto Rico. Latreille described *silius* from a female from Brazil. Riley, 1926, p. 238, states, "Type missing."

Dewitz, *op. cit.*, rather doubtfully refers his two Porto Rican females to *silius* and mentions the redder bands on the front wings on his four male specimens from "Rio."

Under *Cymaenes silius* (Latreille), Godman, 1901, p. 596, Pl. ciii, figs. 4-6, expresses doubt in referring his Central American insect to that species. He had specimens from Brazil which agreed with Latreille's description. Riley, *op. cit.*, refers the above figures to the Mexican form. These figures do not agree well with the original description of *silius* and seem to the author to represent a different species. They represent, at any rate, an insect quite different from the Brazilian specimen that I refer to *silius* Latreille.

The Porto Rican species, described here as new, is totally distinct from the small, dark Cuban *malitiosa* (Herrich-Schaeffer), of which species the Museum collection contains a series of both sexes.

AMERICAN MUSEUM NOVITATES

Number 907

Published by
THE AMERICAN MUSEUM OF NATURAL HISTORY
New York City

February 13, 1937

NEW SPECIES AND RECORDS OF CHINESE SPIDERS

BY IRVING FOX

Through the kindness of Dr. W. J. Gertsch of the Department of Entomology of The American Museum of Natural History, this institution has placed in my hands for study and report two small collections of Chinese spiders made by Bassett Digby in Hong Kong during late January, 1920, and by John Graham in Yunnan Province.

In the study of this material it was necessary to make certain comparisons with specimens reposing in the United States National Museum, and for completeness there is added to this report the description of one new species and notes on several others collected by D. C. Graham in Szechwan Province.

I wish to express my thanks to the authorities of both The American Museum of Natural History and the United States National Museum and especially to Dr. W. J. Gertsch and Dr. E. A. Chapin of their respective institutions.

Agelenidae

Wadotes primus, new species

Figures 1 and 2

FEMALE.—Total length, 8.91 mm. Carapace, 3.76 mm. long, 2.37 mm. wide. Face, 1.32 mm. wide, 0.57 mm. high. Abdomen (exclusive of spinnerets), 4.95 mm. long, 3.00 mm. wide. Carapace with a broad longitudinal median light band about as wide as the first eye-row anteriorly, broadening somewhat on the pars cephalica but narrowing abruptly at the Y-shaped thoracic furrow and thereafter extending to the posterior declivity as a narrow band, about one-half as wide as the broadest portion anteriorly. Sides of the carapace dark brown, with broad marginal light bands on the pars thoracica. Clypeus and chelicerae dark brown, more or less concolorous with the sides of the carapace. Sternum and coxae clear light brown, labium somewhat darker, slightly longer than wide (18/16). Legs light brown, weakly annulate at the femora and tibiae; palpi also light brown, darker distally. Abdomen grayish, without any distinct markings. Anterior spinnerets shorter than the posterior (17/24), the basal and distal joints of the latter subequal.

First row of eyes straight, much shorter than the second (20/27), the anterior laterals much larger than the anterior medians (5/2), the eyes equidistant, separated by about the diameter of an anterior median eye. Posterior row of eyes slightly procurved, the eyes subequal and equidistant, separated by a distance equal to three-fifths the diameter of an eye. The anterior lateral eyes separated from the clypeal

margin by about four-fifths their diameter, the anterior median eyes by about two and one-half times their diameter. Median ocular quadrangle slightly wider than long (13/12), much narrower in front than behind (9/13). Chelicerae robust, 1.76 mm. long, lower margin of the furrow armed with two weak teeth, upper margin armed with three teeth of which the middle is the largest.

Leg formula, 4123. Legs I, 10.99 mm. long; II, 9.01 mm. long; III, 8.51 mm. long; IV, 12.87 mm. long. Anterior tibiae and metatarsi armed with 2-2-2 spines below. Tibia and patella I, 3.17 mm. long, tibia and patella IV, 3.47 mm. long. Epigynum about as wide as long, provided with a median piece attached anteriorly but free posteriorly and divided, consisting of two widely separated branches. For further details regarding the structure of the epigynum see figure 2.

TYPE LOCALITY.—China: female holotype and female paratype from Hong Kong, late January, 1920 (Bassett Digby), the holotype in The American Museum of Natural History, the paratype in the United States National Museum (U. S. N. M. Cat. No. 1232).

So far as can be ascertained from the available literature, this genus has never before been reported from China, nor is it known to occur in Japan.

Lycosidae

Lycosa melica, new species

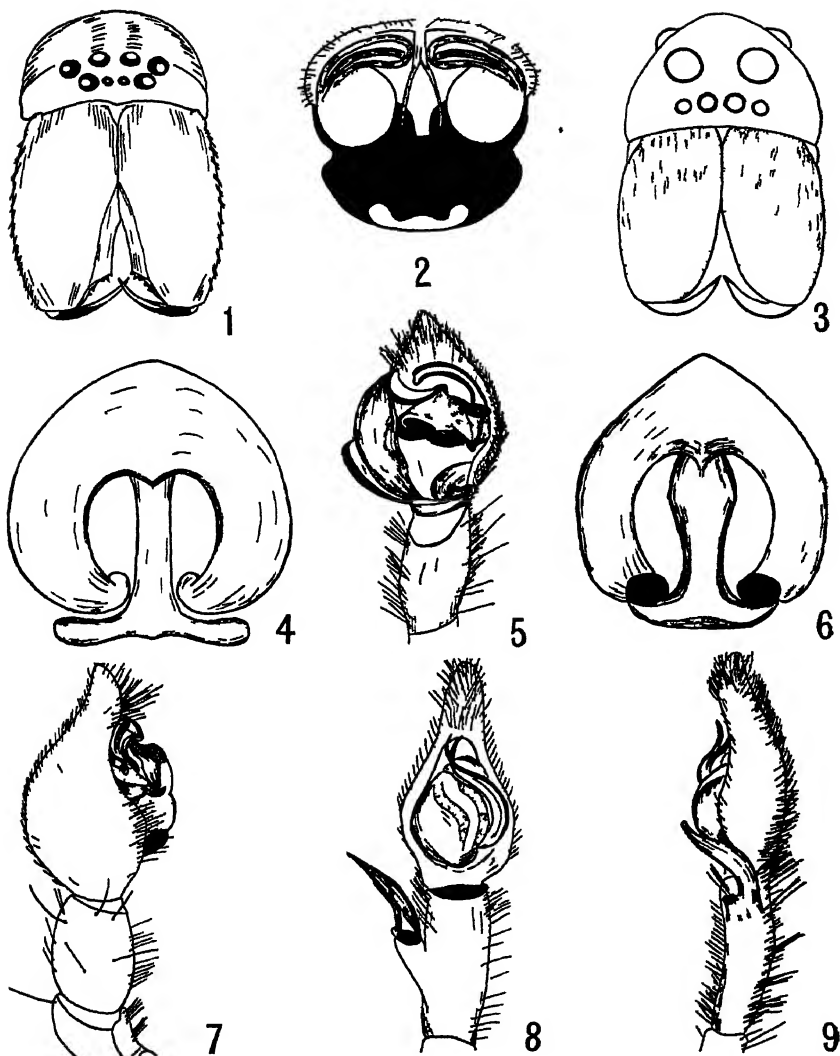
Figures 3 and 4

FEMALE.—Total length, 19.60 mm. Carapace, 9.00 mm. long, 6.21 mm. wide. Abdomen, 11.85 mm. long, 7.90 mm. wide. Dorsum of the carapace dark brown with slight indications of a wide median longitudinal light band. Submarginal bands indistinct or absent; the margins of the carapace black. Eye region black surrounded by reddish-yellow hairs which extend downward covering the clypeus. Chelicerae densely provided with reddish hairs basally, but distally black and with slight pubescence. Sternum, labium, and endites black, somewhat lighter at the margins. Legs reddish brown, without annulations, the anterior tibiae with a hardly perceptible dorsal median dark longitudinal line. Dorsum of the abdomen grayish, basally with a dark mark variable in shape which posteriorly may break into chevrons, bars, or spots. Sides also grayish but the venter black, with irregular spots of gray.

Anterior row of eyes procurved, shorter than the second row (22/25), the medians larger than the laterals (10/6), the eyes equidistant. Quadrangle of posterior eyes wider than long (31/26), the anterior eyes larger than the posterior (10/8). Clypeus slightly more in height than the diameter of an anterior median eye. Chelicerae exclusive of claw, 3.96 mm. long; lower margin of the furrow armed with three robust teeth.

Sternum longer than broad (38/33). All the tibiae armed below with 2-2-2 spines, the last pair apical; tibia III and IV with a proximal and a submedian spine above. Tibia and patella I, 7.82 mm. long, tibia and patella IV, 8.12 mm. long. For the structure of the epigynum see figure 4.

TYPE LOCALITY.—China: female holotype and two female paratypes from Yunnanfu, Yunnan Province (John Graham), the holotype



- Fig 1 *Wadotes primus*, new species, face
 Fig 2 *Wadotes primus*, new species, epigynum
 Fig 3 *Lycosa melica*, new species, face
 Fig 4 *Lycosa melica*, new species, epigynum
 Fig 5 *Pardosa pacata*, new species, palp, ventral view
 Fig 6 *Lycosa atropos* L Koch, epigynum
 Fig 7 *Pardosa pacata*, new species, palp, lateral view
 Fig 8 *Heteropoda hamata*, new species, palp, ventral view.
 Fig 9. *Heteropoda hamata*, new species, palp, lateral view

and one paratype in the collection of The American Museum of Natural History, one paratype in the collection of the United States National Museum (U. S. N. M. Cat. No. 1233).

This species is readily separable from the other oriental members of its genus by the curious coloration of the chelicerae which are provided basally with a sheathlike covering of reddish hairs while distally they are black.

Lycosa atropos L. Koch

Figure 6

Lycosa atropos L. KOCH, 1877, Verh. Zool.-Bot. Gesell. Wien, XXVII, p. 770, Pl. XVI, fig. 34.

MALE.—Total length, 11.88 mm. Carapace 6.24 mm. long, 4.55 mm. wide. Abdomen (exclusive of spinnerets), 5.54 mm. long, 2.87 mm. wide. Carapace dark brown except for a yellowish median dorsal stripe which narrows between the eyes of the third row and has its anterior termination between this row and the second row; the band tapers regularly caudad to the posterior border. Sides with slight indications of submarginal bands. Eye region darker, the eyes on black discolorations. Clypeus dark brown, the chelicerae reddish with black inner edges. Sternum, labium, endites, and coxae light brown, the sternum with a dark median longitudinal mark. Legs light brown, the anterior patellae and tibiae with a dark stripe on each lateral surface, the posterior tibiae with the stripe broken at the middle. Abdomen grayish, the dorsum provided with a basal lanceolate mark that gives off on each side two light bars, one from the middle and one from the caudal end; below this pattern are two distinct light brown chevrons and indications of a third. At the anterior declivity is a dark brown or black mark, almost as wide as the abdomen at that point, portions of which extend to the antero-lateral borders of the dorsum. Sides of the abdomen light gray, the venter with three longitudinal dark bands.

Width of the face, 3.17 mm. First row of eyes shorter than the second (40/46), slightly procurved, the eyes subequidistant with the laterals three-fourths as large as the medians. Quadrangle of posterior eyes wider than long (24/20), the anterior eyes larger than the posterior (3/2). Clypeus about equal in height to the diameter of an anterior median eye. Lower cheliceral margin armed with three robust teeth. Labium longer than broad (14/12), the basal excavations deep (5/14). Posterior spinnerets distinctly longer than the anterior (15/12), the distal joint of the posterior spinneret about half as long as the proximal. Palpus as in L. Koch's figure cited above.

Legs 4123, all the tibiae armed below with three pairs of spines, the distal pair subapical. Tibiae III and IV armed above with basal and submedian spines. The measurements of the legs in millimeters are as follows:

	FEMUR	PATELLA	TIBIA	METATARSUS	TARSUS	TOTAL
I	5.50	2.57	4.55	4.46	2.97	20.05
II	4.95	2.57	2.96	4.55	3.07	18.10
III	4.95	1.98	3.56	4.47	3.00	17.95
IV	6.44	2.48	4.95	7.13	3.47	24.47

FEMALE.—Although the following description is based on a single specimen so injured as to be almost indescribable, it is of value since the female of this species has heretofore been unknown. Carapace, 7.43 mm. long, 4.45 mm. wide. Abdomen (exclusive of spinnerets), 6.63 mm. long, 4.45 mm. wide. Carapace light brown, lateral declivities darker, dorsum with a broad median longitudinal stripe, yellowish in color and with irregular borders, which is constricted anteriorly ending between the second and third eye-rows, broadest anterior to the thoracic groove and tapering posteriorly. Eye region and most of the pars cephalica light. On each side of the dorsal stripe at its posterior termination is a distinct dark brown triangular mark with its apex directed cephalad. Clypeus light brown. Chelicerae reddish, black at the inner edges. Sternum, labium, and endites light brown, the sternum with an irregular median dark mark. Legs as in the male. Dorsum of the abdomen as in the male, venter somewhat darker and not forming distinct bands. The female as a whole is lighter than the male and its markings are not so clearly set off from the background.

Width of the face, 3.56 mm. First row of eyes distinctly shorter than the second (33/40), slightly procurved, the eyes about equally spaced, with the laterals about five-sevenths as large as the medians. Quadangle of posterior eyes wider than long (23/19), the anterior eyes longer than the posterior (16/11). Clypeus about equal in height to the diameter of an anterior median eye. Lower margin of the furrow of the chelicerae armed with three robust teeth equally spaced. Labium longer than broad (13/11). Posterior spinnerets distinctly longer than the anterior, the distal joint of the posterior spinnerets about half as long as the proximal. All the legs except those of the first pair lacking; tibia and patella of this pair, 7.13 mm. long.

Epigynum longer than wide (21/18), posteriorly broad, anteriorly ending in a rounded point. Guide characteristically inverse T-shaped with the transverse bar wide and the longitudinal piece enlarged at the middle. For further details regarding the structure of the epigynum see figure 6.

RECORDS.—China: male and female and two immature females from Hong Kong, late January, 1920 (Bassett Digby), in the collection of The American Museum of Natural History; male from Suifu, Szechwan Province (D. C. Graham), in the collection of the United States National Museum.

In the structure of the palpal organ the male of this species is to all practical purposes indistinguishable from its closely related Chinese allies, *L. coelestis* L. Koch and *L. subcoelestis* I. Fox. The species is unique, however, in the possession of unusually long posterior spinnerets and by these it may readily be separated from the other Chinese members of its genus. Although this character pertains more or less to the subfamily Hippasinae, *L. atropos* finds its proper place in *Lycosa*, for its other structures are characteristic of that genus.

In spite of reasonable activity in the study of Oriental spiders since 1877, when this species was first described, the above finds seem to represent the first record of its occurrence subsequent to that date.

This is explicable on the basis that large collections, in reality containing *L. coelestis* L. Koch, *L. subcoelestis* I. Fox, and *L. atropos* L. Koch could easily have been reported as the first-named species. Since *L. atropos* has been found as far west as Suifu, Szechwan Province, and as far east as Hong Kong, it is believed to occur commonly throughout China and southern Japan.

Pardosa pacata, new species

Figures 5 and 7

MALE.—Total length, 7.69 mm. Carapace, 3.94 mm. long, 2.77 mm. wide. Abdomen, 3.07 mm. long, 1.98 mm. wide. Carapace orange-brown, bearing on each lateral declivity a broad longitudinal dark brown band having irregular borders; eye region dark brown, provided with bars of yellowish hairs laterad between the first and second eye-rows and above the anterior median eyes; dorsum consisting of a light median band beginning a short distance behind the third eye-row, widest at its middle, and narrowing abruptly as it goes down the posterior declivity. Sides with broad submarginal bands concolorous with the dorsum that terminate at the borders of the pars cephalica. Clypeus and chelicerae dark brown. The sternum and labium also dark brown, the former bearing a small irregular light mark at the middle, both contrasting strongly with the coxae and endites which are yellowish. Legs orange, clear below, above the femora bear two or three incomplete annulations, while the tibiae bear a basal and a median annulation. Palpus clear yellow except for the tarsus which is dark brown and contrasts strongly with the other joints. Abdomen yellowish, with a brown median lanceolate mark at the base and five brown transverse bars or chevrons distally. Venter orange or yellow.

First row of eyes slightly procurved, the medians separated from each other by one and one-half diameters, much closer to the laterals which are three-fourths as large. Second eye-row wider than the first (32/25), the eyes separated by one and one-half diameters. Third eye-row wider than the second (39/32), the eyes separated by about three diameters. Quadrangle of posterior eyes broader than long (39/32), narrowed in front. Head portion moderately broad, the width at the posterior eye-row about three-fifths the greatest width of the carapace. Clypeus equal in height to about twice the diameter of an anterior median eye. Lower margin of the furrow of the chelicerae armed with three teeth of which the basal is weak, the others are robust. For the structure of the palpus see figures 5 and 7.

Legs I, 12.97 mm.; II, 12.38 mm.; III, 11.19 mm.; IV, 16.24 mm. The first tibiae armed below with three pairs of spines, of which the basal and submedian pairs are long and robust while the apical is weak.

TYPE LOCALITY.—China: male holotype from Hong Kong, late January, 1920 (Bassett Digby) in the collection of The American Museum of Natural History. Male paratype bearing the same data in the collection of the United States National Museum (U. S. N. M. Cat. No. 1234).

This species resembles *P. multivaga* Simon in the possession of annulate femora and tibiae, but differs in the structure of the palpal organ

and in being larger in size. In its general coloration it is similar to the figure published by Bösenberg and Strand for their *Tarentula depectinata*, but is distinguishable from that species by its complex palpal organ.

Ctenidae

Anahita fauna Karsch

Anahita fauna KARSCH, 1879, Verh. Ver. Rheinl., XXXVI, p. 99, Pl. 1, fig. 18.

RECORD.—China: two immature females from Hong Kong, late January, 1920 (Bassett Digby), one in the collection of The American Museum of Natural History, the other in the United States National Museum.

The generic position of this species will be doubtful until a close examination of mature specimens can be made. Unfortunately, the ones at hand are immature.

Sparassidae

Heteropoda forcipata (Karsch)

Sarotes forcipatus KARSCH, 1881, Berliner Entom. Zeitschrift, XXV, p. 38.

RECORD.—China: male from Yunnanfu, Yunnan Province (John Graham) in the collection of The American Museum of Natural History.

Heteropoda amphora I. Fox

Heteropoda amphora I. Fox, 1936, Jour. Washington Acad. Science, XXVI, No. 3, p. 125, Fig. 1.

RECORD.—China: female from Hong Kong, late January, 1920 (Bassett Digby) in the collection of The American Museum of Natural History.

The discovery of this species in Hong Kong, so far from its type locality in Szechwan Province, indicates that it may be of general distribution in China.

Heteropoda hamata, new species

Figures 8 and 9

MALE.—Total length, 20.79 mm. Carapace, 9.51 mm. long, 8.91 mm. wide. Abdomen, 11.99 mm. long, 6.44 mm. wide. Carapace reddish brown, dorsum with a dark median line extending from between the anterior median eyes to the posterior declivity. Caudal is a broad transverse white band, outlined above and below with black hairs, that is reminiscent of *H. venatoria* (Linnaeus). Sides of the carapace with reddish stripes or bars and narrow marginal black lines. Eye area, clypeus, and chelicerae reddish, the last named structure darkest. Coxae, sternum, and endites clear yellow, the labium darker, edged with light brown. Legs light brown, the first pair somewhat darker than the others. Abdomen dark brown, with a light basal lanceo-

late stripe having on each side two distinct light spots, one at the middle and one at the posterior end. Sides of the carapace concolorous with the dorsum; venter lighter, with two longitudinal dark lines extending from the epigastric furrow almost to the spinnerets.

First and second eye-rows slightly recurved, the former seven-ninths as wide as the latter. Anterior median eyes separated by about a diameter, one-half a diameter from the anterior laterals, and three-fourths as large as the latter. Posterior median eyes separated from each other by more than a diameter, from the posterior laterals by less than two diameters and two-thirds as large as the latter. Median ocular quadrangle longer than wide (20/19), narrower in front than behind (15/19). Clypeus higher than the diameter of an anterior median eye (10/7). Chelicerae with four teeth on the lower margin of the furrow, the one furthest from the claw being the least robust, and three teeth on the upper margin of which the middle one is the most robust. Labium about as long as wide, much shorter than the endites (4/9).

Anterior tibiae with 2-2-2 spines below, the last pair apical, posterior tibiae with 2-2-2 spines below, the last pair apical. Trochanters notched. The legs are too injured to be measured with accuracy. Patella of the palpus slightly smaller than the tibia, the latter with a single curved process, broad basally but curving distally. The palpus resembles that of *H. forcipata* Karsch but differs in that the tibia is provided with a single process rather than with two in a forceps-like arrangement. For further details regarding the structure of the palpus see figures 8 and 9.

TYPE LOCALITY.—China: male holotype and a male paratype from Yachow, Szechwan Province, May-June, 1928 (D. C. Graham). The holotype in the collection of the United States National Museum (U. S. N. M. Cat. No. 1235), the paratype in the collection of The American Museum of Natural History.

The records available indicate that eight Chinese spiders have been referred to *Heteropoda*, but of these two are of doubtful validity. Strand has offered good reasons for the belief that *H. aulica* L. Koch is equivalent to *H. venatoria* (Linnaeus), or at most a subspecies of it, and that *H. peditata* (Karsch) is identical to *H. invicta* L. Koch. Until more is known about this genus, which bids fair to become an important one in China, it will not be possible to ascertain the correct status of the questionable species. *H. venatoria* (Linnaeus), *invicta* L. Koch, *forcipata* (Karsch), *amphora* I. Fox, and the new species described above are similar in general appearance forming a distinct group whose members are brown in color and possess a white transverse band at the posterior border of the carapace as well as a more or less distinct yellow one on the clypeus. The small species, *H. virgata* and *H. grahami* I. Fox differ somewhat from the group, the former being pale without distinct markings, as far as can be judged from the holotype, and the latter yellowish and maculate with red. Although at the time of its description *H. grahami* was believed to be an ally of the uncertain *H. aulica* because of its

resemblance in the epigynum to L. Koch's figure of that structure in his species, it is now known to be distinct and not related to that species.

Gnaphosidae

Gnaphosa compirensis Bösenberg and Strand

Gnaphosa compirensis BÖSENBERG AND STRAND, 1906, Abh. Senckenb. Naturf. Gesell., XXX, p. 123, Pl. XVI, fig. 481.

RECORD.—China: four females from Mupin, Szechwan Province, July, 1929 (D. C. Graham), one in The American Museum of Natural History, the others in the United States National Museum; a female from Shin-Kai-Si, Mt. Omei, 4400 ft., and one from Suifu, Szechwan Province, 1000 ft., June, 1930, in the United States National Museum.

Gnaphosa sinensis Simon

Gnaphosa sinensis SIMON, 1880, Ann. Soc. Ent. France, (5) X, p. 121, Pl. III, figs. 22, 23, and 24.

RECORD.—China: male from Mt. Omei, Szechwan Province, July, 1921, and a male from Yachow, 2200 ft., August 4, 1930 (D. C. Graham), in the United States National Museum.

AMERICAN MUSEUM NOVITATES

Number 908

Published by
THE AMERICAN MUSEUM OF NATURAL HISTORY February 13, 1937
New York City

THE PHYSIOLOGY, LIFE CYCLES AND PHYLOGENY OF THE PARASITIC FLATWORMS¹

BY HORACE W. STUNKARD

The present account is restricted to those classes of the phylum Platyhelminthes whose members are obligate parasites. This arbitrary limitation is made despite the obvious fact that many of the turbellarians are parasitic and that the exclusively parasitic groups have a common ancestry with the Turbellaria. Although the forms are genetically related, the free living and parasitic species are so unlike in life history and metabolic activities that they constitute two distinct groups, so widely separated that the characteristics and methods of study applicable to one are entirely inadequate for the other.

The adoption of the parasitic habit has led to modification of the parasite, particularly the digestive and reproductive systems, with attendant alterations in metabolism and in the course of the life cycle. Ordinarily the worm becomes sexually mature in or on a definite organ and passes the remainder of its life there. For perpetuation of the species, it is essential that dispersal stages of the parasite leave the definitive host and accomplish the infection of new hosts. If two or more host species are required to complete the life cycle, there may be a corresponding number of infective larval stages. In the long period of evolutionary history there have been many changes in the relations between hosts and parasites. While there is much uncertainty concerning the phylogeny of the parasitic flatworms, it is patent that parasitic species have been derived from free living ancestors and that present life cycles are in many cases very different from the original ones. Former hosts have become extinct and certain of their parasites, modified in form and life history, have passed on to other hosts. Moreover, former hosts, serving as food for other animals, have carried their parasites into new host species where they have become established. Such a history has led to alternation of hosts and the interpolation of new hosts, to accessory methods of reproduction, to metamorphosis and peculiar types of metagenesis.

The profound changes which have occurred in the life cycles and

¹Contribution from the Biological Laboratory, New York University, and the Department of Lower Invertebrates, The American Museum of Natural History.

metabolism of parasitic species have so modified their physiological requirements that they have become incapable of free-living existence and are dependent on their hosts for nourishment. The problem is complicated by the fact that the life cycles of most parasitic flatworms comprise two or more successive generations which may infest different host species and for which the essential conditions and nutritional demands may be very dissimilar. Their physiology has been studied very little and the factors which determine host-parasite specificity are quite unknown. The basis of the relationship is chemical and the adjustment has developed gradually during a long period of association. Certain parasites manifest very rigid host-parasite specificity while others may complete their development in a variety of different hosts.

An excellent review of present knowledge concerning the respiration, metabolism and nutrition of parasitic worms was made by McCoy (1935). The normal habitat of these worms is varied and those which live in the intestine must exist in the virtual absence of oxygen. Biochemical studies on *Fasciola hepatica*, *Moniezia expansa* and *Triaenophorus nodulosus* have shown that they live equally well in the presence or absence of oxygen. Under anaerobic conditions the worms consume glycogen with the production of CO₂ and fatty acids while in aerobic conditions the consumption of oxygen varies directly with the oxygen tension of the medium. The CO₂ production is the same under anaerobic and aerobic conditions and bears no constant relation to the oxygen consumption. The exact rôle of oxygen in metabolism is doubtful and all of the results are subject to the criticism that the experiments were not performed under sterile conditions. It is impossible at present to determine to what extent the results have been influenced by the activities of bacteria. Since cestodes have no alimentary tract, their nutrition must be entirely saprophytic, while the nutritional requirements of trematodes probably vary in different species. Certainly the flukes which infest the lungs, blood vessels, intestine, liver and urinary bladder live in very diverse habitats. To what extent digestion is extracellular or intracellular, and whether the worms utilize only soluble products or whether they feed on cells and tissue exudates, is as yet uncertain.

Since the environmental conditions are so unlike during different periods of the life cycle, the physiological processes of parasitic flatworms must vary to a considerable degree. There is much evidence that the worms are not deleteriously affected by wide variations in environmental conditions, and changes in such factors as pH, CO₂, temperature and constitution of the external milieu may have only slight effects. In

contrast to these observations is the well-known host-parasite specificity which in certain instances almost limits a particular parasite to a single host species.

None of the parasitic flatworms has ever been raised in artificial media and at present the only feasible method of culturing these animals is to maintain them in or on appropriate hosts. Attempts to grow them *in vitro* have resulted in failure, largely because there is no adequate knowledge of their metabolic requirements. Attempts to culture these parasites have been confronted by two horns of a dilemma. The worms cannot be maintained *in vitro* because their physiology is so imperfectly understood, and their physiological processes cannot be subjected to controlled study since the worms cannot be maintained under experimental conditions. The writer (1930, 1932) has reported attempts to culture the trematode *Cryptocotyle lingua* and the cestode *Crepidobothrium lönnbergi* in nutrient media. This trematode was selected because it does not have a rigid host specificity and develops in many animals. Furthermore, it reaches maturity in about six days. Various methods were tried to secure specimens free from bacteria, but none was entirely successful. The worms not only failed to grow, but actually diminished in size during the experiment. *Crepidobothrium lönnbergi* was selected because it is parasitic in a poikilothermous animal and the experiments could be conducted at room temperature. In this species some growth and development was obtained, but the strobilas were abnormal in appearance and the proglottids were sterile. Although these studies attained little in the way of successful results, they indicate that the problem can be solved. The development of techniques by which metazoan endoparasites can be grown in artificial media would be a most important step in the advancement of knowledge of the parasitic flatworms.

The life cycles of most species are complicated and it is only in recent years that substantial progress has been made in the elucidation of the successive developmental stages. Indeed, most of the known life histories have been discovered in the last ten years, and the number of life cycles which have been experimentally demonstrated is exceedingly small when compared with the number as yet unknown. Among the developmental cycles which have been reported, many are incompletely described. Frequently only a portion of the cycle is sketched with suggestions concerning the probable course of development. A further distressing situation results from the fact that it is often extremely difficult to complete known life histories under laboratory conditions.

All members of a natural family follow a similar course of development and it has become clearly evident that types of life cycle are closely correlated with phylogenetic and systematic relations of the worms. The life cycles of animals, and especially parasitic ones, provide the best evidence of their genetic relations and systematic position. Actually, in species which have undergone excessive adaptation, the developmental stages afford the only adequate and satisfactory data on which to base a determination. The pronounced degeneration of many parasitic flatworms, involving the more or less complete loss of the digestive tract and the interpolation of accessory methods of reproduction, indicate a very long period of parasitic existence. Evidence of the remote origin of the digenetic trematodes was noted by Stunkard and Shaw (1931) from the observation that closely related species infest marine and fresh-water hosts that have been distinct since the Mesozoic era.

If habitat, degree of degenerative change and extent of adaptation are taken as criteria, the parasitic flatworms may be arranged in the following sequence: Mesozoa, Cestoidea and Trematoda. Each of the classes is composed of two more or less distinct groups. The Mesozoa contain the orders Rhombozoa and Orthonectida; the Cestoidea comprise the subclasses Cestodaria and Cestoda; while the Trematoda contain the subclasses Digenea and Monogenea. The Mesozoa are simple degenerate organisms, which infest marine invertebrates, and which have probably been parasitic since early geologic periods. The Cestoidea, perhaps less ancient, were originally parasites of invertebrates and most of them still pass their early developmental stages in arthropods or annelids. The subclasses of the Trematoda are not closely related, since the Digenea were probably parasites of molluscs before the advent of higher vertebrates, while the Monogenea have adopted the parasitic habit at a more recent period and infest only vertebrate hosts.

LITERATURE

- McCoy, O. R. 1935. 'The physiology of the helminth parasites.' *Physiol. Reviews*, XV, pp. 221-241.
- STUNKARD, H. W. 1930. 'The life history of *Cryptocotyle lingua*, with notes on the physiology of the metacercariae.' *Jour. Morph.*, L, pp. 143-191, Pls. I-IV.
1932. 'Attempts to grow cestodes *in vitro*.' *Jour. Parasit.*, XIX, p. 163.
- STUNKARD, H. W., AND C. RUTH SHAW. 1931. 'The effects of dilution of sea water on the activity and longevity of certain marine cercariae, with descriptions of two new species.' *Biol. Bull.*, LXI, pp. 242-271, 1 Pl.

MESOZOA

The name Mesozoa was proposed by Éd. van Beneden (1876) to denote a group of organisms which he regarded as intermediate between Protozoa and Metazoa. These animals were discovered in the renal sacs of cephalopod molluscs by Krohn (1839) and had been studied by K  lliker (1849), Wagener (1857), Clapar  de and Lachmann (1861), Lankester (1873) and P. J. van Beneden (1875).   . van Beneden characterized the Mesozoa as animals without germ layers or gastrula formation, and originally the group contained only the dicyemids. The orthonectids were discovered by Keferstein (1868) and the study of these animals by McIntosh (1874), Giard (1877, 1879) and Metschnikoff (1881) led to their inclusion in the Mesozoa. Other inadequately described species have been appended tentatively to the group.

The zo  logical position of the Mesozoa is yet uncertain and students of these parasites have held very different opinions concerning their true status. Clapar  de and Lachmann related them to the Infusoria and particularly to the Opalinidae. P. J. van Beneden placed them with the gregarines and Foettinger (1881) listed them as parasitic Infusoria. Hatschek (1888) noted the similarity between these organisms and the planula stage of certain Cnidaria and proposed for them the name Planuloidea, as an appendix to the Coelenterata. Lameere (1918, 1922) advanced an ingenious and plausible thesis relating the Mesozoa to the echinurids. He stated (1922, p. 784), "Les pr  tendu M  sozoaires sont par cons  quent des Vers du groupe des   chinuriens d  riv  s du genre *Bonellia*, chez lesquels le nanisme et la d  g  n  rescence accompagnant la vie parasitaire ont affect   la femelle aussi bien que le m  le." Metschnikoff (1879), Giard (1879), Leuckart (1882), Braun (1893) and other parasitologists have considered the Mesozoa as degenerate flatworms.

Two excellent studies on the dicyemids of the Mediterranean and of the Pacific coast of North America, respectively, were done by the eminent American zo  logists, Whitman (1882) and Wheeler (1899). Both opposed the idea of van Beneden to establish a separate subkingdom for the Mesozoa and Whitman, after a careful embryological study, concluded: "I see no good reason for doubting the general opinion that they are Plathelminths degraded by parasitism."

In a recent monograph Hartmann (1925) contended that the Mesozoa cannot be compared either with a planula or with an epibolic gastrula, nor with any developmental stage higher than a morula. He maintained that their organization is definitely more simple than that of true

Metazoa in which a gastrula appears in development. Furthermore he stated that they manifest a "primary" alternation of generations and a primitive agametic type of reproduction which occurs among the Protozoa but not among the Metazoa. The concept of Hartmann is very similar to the original one of van Beneden. Hartmann defined the Mesozoa as multicellular animals of morula-like form, which consist of a somatoderm and a reproductive organ, and which have a "primary" alternation of generations. According to him the Phylum Mesozoa contains a single class, the Moruloidea, with two orders, Rhombozoa and Orthonectida. In the Rhombozoa he listed two families, Dicyemidae and Heterocyemidae. It should be noted, however, that the family Heterocyemidae contains only the two genera *Conocyema* and *Microcyema*. Since the name of the family must be formed from the stem of the name of the type genus plus the ending IDÆ, it is apparent that the name Heterocyemidae is not valid. For the family Heterocyemidae of Hartmann, I propose the name Conocyemidae with *Conocyema* as the nomenclatorial type. Similarly, in the Orthonectida, Hartmann recognized the family Orthonectidae in which he included the two genera *Rhopalura* Giard and *Stoecharthrum* Caullery and Mesnil. For this family I propose the name Rhopaluridae. Furthermore, Hartmann listed the family Heteronectidae, with a single genus *Pelmatosphaera*. Since this family contains a single genus, the name of the family must become Pelmatosphaeridae. Hartmann described the reproductive stages of the Dicyemidae which occur in the mollusc but admitted uncertainty concerning the method by which new infections are established. He declared that it is impossible, because of their parasitic mode of life, to determine whether the organization of the Dicyemidae and Orthonectidae is progressive or retrogressive, but that in a taxonomic treatment of the Mesozoa it is not essential to determine whether their simplicity is primitive or secondary.

On the last two points the opinion of Hartmann appears to be at variance with established biological principles. The ideas advanced by Hartmann were presaged and proscribed by the statement of Whitman (1882), "Thus far no objection has been raised to the creation of a middle division of the animal kingdom on the ground that all the assumed representatives of this division are parasites. But I think this must be admitted to be one of the unfortunate aspects of the case, although we may not be able to point to undeniable evidence of degeneration. But who will venture to assert, before applying the hypothesis of 'degenerative evolution,' it is indispensable to find unmistakable marks

of degeneration, such as are seen, for example, in the development of *Sacculina*, *Lernaecera*, *Barnacles*, etc.? That this hypothesis admits of a very wide application to the simpler forms of life has been made sufficiently clear by Dohrn (27) and Lankester (40). When we find an animal in the form of a simple sack, filled with reproductive elements, secured by position against enemies, supplied with food in abundance, and combining parasitism with immobility, we have strong reasons for believing that the simplicity of its structure is more or less the result of the luxurious conditions of life which it enjoys, even if its development furnishes no positive evidence of degeneration." In addition to the strong presumptive evidence cited by Whitman, there are certain features which may be regarded as positive evidence of parasitic degeneration, but a final decision can be reached only when the development of the Dicyemidae is completely known. If parasitism has led to progressive evolution in the Mesozoa, as suggested by Hartmann, it is a most unusual and remarkable occurrence, and one that could be accepted only when supported by incontestable proof. All available evidence appears to indicate that the simplicity of the Mesozoa is secondary and the result of parasitic adaptation. If it should be established that the simplicity is not primitive, the basis of Hartmann's classification would disappear, together with his assertion that the nature of the simplicity (whether primitive or secondary) may be disregarded in systematic considerations.

For the present at least, I am disposed to regard the Mesozoa as degenerate or highly specialized flatworms, derived not from any existing group of the Turbellaria but from a very remote ancestor of all existing flatworms. They probably branched off a primitive stem before the origin of the digenetic trematodes or cestodes. The free swimming larvae are modified planulae and bear many resemblances to the larvae of the trematodes.

RHOMBOZOA

These organisms occur on the venous appendages of the excretory organs of cephalopod molluscs. Their life cycle is very imperfectly known. The development of the successive stages in the mollusc has been described by several authors, but there is much difference of opinion concerning the infusorigen and infusiform stages. Earlier authors described the infusorigen individuals as females and the infusiform embryos as males, but Lameere (1918, 1922) contended that the infusorigens are hermaphroditic, that there are no males, and that the infusiform is

an infective stage which leaves the cephalopod and transmits the infection to a new host. He advanced the hypothesis that the infusiform may enter some host other than a cephalopod and that there may be another generation or series of generations in an as yet unknown host. The observations of Lameere concerning the sequence of stages in the mollusc confirmed those of Wheeler (1899). The recent studies by Nouvel (1929, 1932, 1933) support the opinion of Lameere concerning the life cycle.

ORTHONECTIDA

The Orthonectida are parasites of planarians, nemertines, annelids, echinoderms and molluscs. There is an alternation of generations; the sexual phases are free living in the sea and the asexual stages occur in plasmodia in the tissues of various animals. In dioecious species the males and females are distinguished by differences in size and form. Certain species are hermaphroditic and it is believed that the monoecious condition is secondary, although the development of the sexual conditions is not well known. In a recent paper Atkins (1933) described the successive stages and swimming behavior of *Rhopalura granosa*, a species which infests the lamellibranch mollusc, *Heteranomia squamula*.

LITERATURE

- ATKINS, D. 1933. '*Rhopalura granosa*, sp. nov., an orthonectid parasite of a Lamellibranch, *Heteranomia squamula* L., with a note on its swimming behavior.' Jour. Mar. Biol. Assn. Plymouth, XIX, pp. 233-252, 4 Figs.
- BENEDEN, ÉD. VAN. 1876. 'Recherches sur les Dicyémides, etc.' Bull. l'acad. Roy. de Belgique, (2) XLI, pp. 1160-1205, and XLII, No. 7.
- BENEDEN, P. J. VAN. 1875. 'Commensaux et Parasites.' Paris.
- BRAUN, M. 1893. 'Miohelminthen.' in Bronn's 'Klassen und Ordnungen des Tierreichs,' IV.
- CLAPARÈDE, ÉD., AND J. LACHMANN. 1861. 'Études sur les Infusoires et les Rhizopodes.' 'Genève et Bâle,' part 3, pp. 201-206, Pl. xi.
- FOETTINGER, A. 1881. 'Recherches sur quelques Infusoires Nouveaux, Parasites des Céphalopodes.' Arch. Biol., II, pp. 345-378, Pls. XIX-XXII.
- GIARD, A. 1877. 'Sur les Orthonectida, classe nouvelle d'animaux parasites des échinodermes et des turbellariés.' Compt. rend. Acad. Sci., LXXXV, p. 812.
1879. 'Les Orthonectides, Nouvelle Classe du Phylum des Vermes.' Jour. Anat. et Physiol., XV, pp. 449-464, Pls. XXXIV-XXXVI. Also Quart. Jour. Micr. Sci., XX.
- HARTMANN, M. 1925. 'Mesozoa,' in Kükenthal und Krumbach, 'Handbuch der Zoologie, I,' pp. 996-1014, Figs. 846-868.
- HATSCHKE, B. 1888. 'Lehrbuch der Zoologie.' Jena.

- KEFERSTEIN, W. 1868. 'Beiträge zur Anatomie und Entwicklungsgeschichte einer Seepflanzen.' Abhand. könig. Gesell. Göttingen, XIV, pp. 3-38, Pls. I-III.
- KÖLLIKER, A. 1849. 'Über *Dicyema paradoxum*, den Schmarotzer der Venenan-hänge der Cephalopoden.' 2ter Bericht d. Zootom. Anstalt, Wurzburg, No. 8, pp. 59-66, Pl. v, (Leipzig).
- KROHN, A. 1839. 'Über das Vorkommen von Entozoen und Krystallablagerungen in den schwammigen Venenanhängen einiger Cephalopoden.' Fro-riep's 'Neue Notizen,' XI, pp. 213-216.
- LAMEERE, A. 1918. 'Le cycle évolutif des Dicyémides.' Bull. Soc. Zool. France, XLII, pp. 122-126. Also in C. R. Acad. Sci., CLXVII, pp. 1058-1062.
1922. 'L'histoire naturelle des Dicyémides.' Bull. l'Acad. Roy. de Bel-gique, (5) VIII, pp. 779-792.
- LANKESTER, E. R. 1873. 'Summary of observations made at Naples in the winter of 1871-1872.' Ann. Mag. Nat. Hist., Ser. 4, XI, pp. 81-97.
- LEUCKART, RUDOLPH. 1882. 'Zur Entwicklungsgeschichte des Leberegels.' Arch. Naturg., 48 Jahrgang, I, pp. 80-119, Pl. VIII.
- METCHNIKOFF, E. 1879. 'Zur Naturgeschichte der Orthonectiden.' Zool. Anz., II, pp. 547-549.
1881. 'Untersuchungen über Orthonectiden.' Zeit. wiss. Zool., XXXV, pp. 282-303, Taf. xv.
- McINTOSH, W. C. 1874. 'A monograph of the British Annelids.' I. Nemertean. Pub. by Roy. Soc., pp. 97-214, Pls. XI-XXIII.
- NOUVEL, H. 1929. 'Observations préliminaires sur les constituants cytoplasmiques et le micrometabolisme de quelques Dicyémides.' Bull. Soc. Zool. France, LIV, pp. 124-128.
1932. 'Un Dicyémide nouveau du poulpe, *Dicyemennaea lameeri*, n. sp.' Idem, LVII, pp. 217-223, 4 Figs.
1933. 'Recherches sur la cytologie, la physiologie et la biologie des Di-cyémides.' Ann. Inst. Oceanogr., XIII, pp. 167-255, 1 Pl., 53
- WAGENER, G. R. 1857. 'Über *Dicyema* Kölliker, etc.' Müller's Archiv, (1857), pp. 344-364.
- WHITMAN, C. O. 1882. 'A contribution to the embryology, life-history and classi-fication of the Dicyemids.' Mitt. Zool. Stat. Neapel, IV, 89 pp., 118 Figs.
- WHEELER, W. M. 1899. 'The life history of *Dicyema*.' Zool. Anz., XXII, pp. 169-176.

CESTOIDEA

This class of the Platyhelminthes is extensively adapted to the parasitic habit. Except for the occasional appearance of ephemeral larval stages these worms are endoparasites, and all traces of a digestive system have disappeared. With rare exceptions, the adult stages live in the intestine of vertebrates. The mature worms lack sense organs and the body is covered with cuticula. Typically the body consists of scolex, neck and

strobila, although any one of these parts may be absent. Except for species of the genus *Dioecocystus*, all members are hermaphroditic. In monozoic species there is a single set of male and female reproductive organs, while in merozoic ones the gonads are serially repeated in more or less completely distinct proglottids. Occasionally the male and female organs may be duplicated in each proglottid. The Cestoidea may be arranged in two subclasses, Cestodaria and Cestoda.

CESTODARIA

The Cestodaria are a small group of monozoic forms in which the larva (Lycophora) contains ten hooks. There are two orders, Amphilinea and Gyrocotylidea, each composed of a single family. The Amphilinidae are parasitic in the body cavity of ganoid fishes, the Gyrocotylidae in the intestine of selachians. Members of the Amphilinidae occur infrequently in the body cavities of teleost fishes and according to Woodland (1923) the worms, when sexually mature may bore through the body wall. In ganoid fishes, eggs of the parasite pass out through the abdominal pores. The life cycle of *Amphilina foliacea* was discovered by von Janicki (1928). Eggs of the parasite are eaten by species of *Gammarus* and related crustaceans; the embryos develop in the body cavity to the plerocercoid stage. Since the final hosts feed on these crustaceans it is probable that no other host is required. The early stages in the life history of *Gyrocotyle* were described by Ruszkowski (1931).

The older authors and more recently Woodland (1926) regarded all monozoic species as members of the Cestodaria. Lühe (1910), Nybelin (1922), Hunter (1930) and Fuhrmann (1931), however, considered the Caryophyllaeidae as secondarily monozoic and members of the Pseudophyllidea.

LITERATURE

- FUHRMANN, O. 1931. 'Vermes Amera. Cestoda,' in Kukenthal und Krumbach, 'Handbuch der Zoologie,' 2 (Lief. 11) Teil. 2, pp. 257-416, Figs. 286-435.
- HUNTER, GEORGE W., 3d. 1930. 'Studies on the Caryophyllaeidae of North America.' III. Biol. Monogr., XI (No. 4), pp. 1-186, 7 Pls.
- JANICKI, C. VON. 1928. 'Die Lebensgeschichte von *Amphilina foliacea* G. Wagen., Parasiten des Wolga-Sterlets, nach Beobachtungen und Experimenten.' Arbeit. biol. Wolga-Station, X, pp. 101-134, 5 Taf., 3 Figs.
- LÜHE, M. 1910. 'Parasitische Plattwürmer. II Cestoda.' (In: 'Die Süßwasserfauna Deutschlands,' hrsg. V. Brauer).

- NYBÆLÉN, O. 1922. 'Anatomisch-systematische Studien über Pseudophyllideen.' Göteborg Vet.-Handl., XXVI, pp. 1-228, 118 Figs.
- RUSZKOWSKI, J. S. 1931. 'Études sur le cycle évolutif et la structure des Cestodes de mer. II. Sur les larves de *Gyrocotyle urna* (Gr. et Wagen.)' Bull. Acad. polon. Cracovie, (B), pp. 629-641, 2 Figs., Pl. xli.
- WOODLAND, W. N. F. 1923. 'On *Amphilina paragonopoda*, sp. n., and a hitherto undescribed phase in the life-history of the genus.' Quart. Jour. Micr. Sci., LXVII, pp. 47-84, Pls. iii-v.
1926. 'On the genera and possible affinities of the Caryophyllaeidae: a reply to Drs. O. Fuhrmann and J.-G. Baer.' Proc. Zool. Soc. London, pp. 49-69, 8 Figs.

CESTODA

The subclass Cestoda contains a large assemblage of species, all of which, with the exception of those in the family Caryophyllaeidae, are merozoic and form a more or less distinct strobila. The larva (*Onchosphaera*) contains six hooks and lacks the clear structural differentiation of the *Lycophora*. There are five orders and the life histories in each will be discussed separately.

The metabolism of cestodes is obscure and there is no satisfactory explanation why the living worms are not digested in the intestine of their host. Since cestodes have no digestive tract, their nutrition must be entirely saprophytic. Their nutritional requirements cannot be very rigid, however, since the content of the alimentary tract is inconstant in amount and character and the worms are normally subjected to greatly varying conditions. Numerous attempts have been made to maintain these worms *in vitro* but the results, from those of Lönnberg (1892) to those of Wardle (1934), have been disappointing. The latter paper contains a good bibliography.

TETRAPHYLLIDEA

Members of the order Tetraphyllidea occur in the intestine of fishes, amphibians and reptiles. The Phyllobothriidae, Onchobothriidae, Lecanicephalidae, Cephalobothriidae and Discocephalidae infest selachian fishes, while the Monticellidae parasitize siluroid fishes. Members of the family Proteocephalidae (*Ichthyotaeniidae*) occur in fresh-water fishes, amphibians and reptiles. Larvae of the marine species have been found in copepods and later stages in teleosts, molluscs and larger crustaceans. No life cycle has been completely traced but there is evidence of asexual multiplication of the larvae and it is probable that two intermediate hosts are involved.

In the family Proteocephalidae, the life history of several species has

been discovered. An account of the early work is contained in the paper by Essex (1928a). The complete life cycle of *Proteocephalus filicollis* was traced by Meggitt (1914). Sexually mature stages occur in the stickleback and *Cyclops varius* was found to be the first and only intermediate host. A similar life cycle was described by Wagner (1917) for *Proteocephalus torulosus*. Adult worms infest *Cyprinus orfus* while *Cyclops strenuus* and *Diaptomus castor* serve as first intermediate hosts. Kuczkowski (1925) found that the larvae of *P. percae* and *P. longicollis* develop in species of *Cyclops*. Essex (1928a) described the life history of two species of *Corallobothrium* which occur in catfishes. Infection was produced in species of *Cyclops* by feeding eggs of the cestodes. The infected cyclops were fed to minnows, *Notropis blennius*, and the larvae were recovered from the body cavity. Catfishes became infected by eating either the infected cyclops or infected minnows. Essex showed that ordinarily two intermediate hosts are involved in the life cycle although the second intermediate or transfer host is not absolutely essential. Apparently the larvae develop only in particular species of crustaceans and if these crustaceans are eaten by an animal other than the normal host the larvae bore from the intestine to the body cavity. In the normal host they remain in the lumen of the intestine and attain sexual maturity. Other recent American contributions include the studies of Hunter (1928, 1929), Magath (1929) and Thomas (1931).

DIPHYLLIDEA

The order Diphyllidea contains a single genus *Echinobothrium*. Sexually mature stages live in the intestine of selachian fishes and larvae of these cestodes have been reported from marine crustaceans and molluscs. Ruzskowski (1927) described the life cycle of *E. benedeni*, in which the larvae were found in the decapod crustacean *Hippolyte varians*. He gave a complete historical review of the group and concluded that there is a single intermediate host.

TETRARHYNCHIDEA

The tetraarhynchid cestodes are principally parasites of selachian fishes although species have been reported from *Silurus glanis* and *Lota lota* in Swiss lakes and *Haplobothrium globuliforme* occurs in the intestine of *Amia calva*. The eggs contain a ciliated larva, coracidium, and larval stages have been reported in the coelom and other organs of holothurians, molluscs, crustaceans and fishes. Although the complete

life history is not known for any of the marine species, Dollfus (1929, 1930) divided the order into two groups; Acystidea, in which the larva is a plerocercoid; and Cystidea, in which the larva is a tailed or tailless cysticeroid (plerocercous). More recently (1935) in a preliminary note he has announced the inaccuracy of this arrangement. The life cycle of *H. globuliforme* is known through the studies of Essex (1929) and Thomas (1929). The coracidium is eaten by species of *Cyclops* and the second larval stage occurs in the liver of *Ameiurus nebulosis* and the sunfish. Part of the life cycle of *Grillotia erinaceus* was described by Ruszkowski (1932). The present fragmentary knowledge concerning the development of the tetrahyarchid cestodes indicates that members of this group typically have a three-host life cycle.

PSEUDOPHYLLIDEA

Members of this order infest all classes of vertebrates and one genus, *Archigetes*, contains species, possibly neotenic, which become mature in the coelom of oligochaete annelids. The first life cycle in this order to be experimentally demonstrated was that of *Diphyllbothrium latum*, the human fish tapeworm, by Janicki and Rosen (1917). A more detailed study of the development of this species was done by Vogel (1929, 1930). *D. latum* is now endemic in the United States and a series of studies in this country has confirmed the earlier accounts. Ciliated embryos (coracidia) emerge from the eggs and are eaten by copepods. The larvae bore into the body cavity of the crustacean where they develop into proceroids. The infected copepods are eaten by small fish and the larvae pass into the muscles where they become plerocercoids. If these small fish are eaten by other larger fishes the larvae migrate again to the muscles. When fish containing mature plerocercoids are eaten by the final host the larvae remain in the intestine and develop to sexual maturity. Rosen (1918) described similar life cycles for *Tri-ae-nophorus nodulosus* and *Abothrium infundibuliforme* although Fuhrmann (1931) reproduced Rosen's figures of *A. infundibuliforme* and assigned them to the species *Eubothrium crassum* (Bloch). Similar life cycles were described for *Ligula simplicissima* by Rosen (1919); for *Diphyllbothrium mansonii* by Joyeux and Houdemer (1928); for *Diphyllbothrium decipiens* and *D. erinacei* by Li (1929); for *Bothriocephalus cuspidatus* by Essex (1928b); for *Schistocephalus solidus* by Callot and Desportes (1934).

While most of the pseudophyllideans have a three-host life cycle, there are some exceptions. The larvae of *Cyathocephalus* occur in

Gammarus and a two-host cycle is indicated. In the aberrant family Caryophyllaeidae the life cycle is reduced. The larvae of *Caryophyllaeus* have well formed gonads while still in the coelom of oligochaete annelids and it is most unlikely that a third host is required. The researches of Wisniewski (1930) have shown that in the genus *Archigetes*, the life cycle is completed in a single host species.

CYCLOPHYLLIDEA

Among cyclophyllidean or taenoid cestodes ordinarily only one intermediate host is necessary. These worms have three stages in the life cycle. The eggs develop within the uterus of the worm until they contain infective larvae. Such embryonated eggs, either separately or contained within a segment of the worm, pass from the intestine of the primary host and, with rare exceptions, develop further only when ingested by a suitable intermediate host.

In the intestine of the intermediate host the onchospheres emerge, and by use of their hooks, penetrate the intestinal wall. If the intermediate host is an invertebrate, the onchospheres invade the body cavity and complete the second stage of their life cycle, developing into cysticercoid larvae. Typically, these larvae have more or less solid bodies and caudal appendages or cercomeres in which the six hooks of the first larval stage may be cast off. The body develops the scolex of the future cestode with its adhesive organs, ready for attachment when introduced into the intestine of the primary host. Cysticercoid larvae occur chiefly in invertebrate hosts, and they have been found in crustaceans, insects, myriapods, oligochaetes, leeches and molluscs.

In case the intermediate host is a vertebrate, the onchospheres on piercing the intestinal wall reach the lymph spaces or veins and pass by way of the portal system to the liver. They may continue their development to the next infective stage in the liver or they may pass to other organs. These larvae develop fluid filled vesicles and are known as cysticerci or bladder worms. In any event, the second stage in the life cycle is completed when the larva, either cysticercus or cysticercoid, has developed sufficiently to be infective for the primary host.

The third stage of development occurs in the intestine of the primary host. When the cysticercoid or cysticercus is ingested, larval coverings if present are digested; the larva attaches itself to the intestinal wall and develops into the sexually mature cestode.

From known life histories a few generalizations may be made. The onchosphere is exceedingly delicate, quite incapable of independent

existence. It is always passively introduced within its coverings into the the intestine of the next host. Ordinarily it does not spontaneously emerge except in the intestine of an appropriate intermediate host. The onchosphere will not remain in the intestine, but always penetrates the wall to reach the body cavity or other organs where development proceeds. With rare exceptions, multiplication does not occur in the larval stage. In almost all known life histories, the larva after developing to an infective stage in a suitable intermediate host, is accidentally ingested by the final host with food, and sexually mature cestodes are usually found in carnivorous vertebrates.

In a few instances, viz., species of *Hymenolepis* and *Cylindrotaenia*, direct development may occur without the intervention of an intermediate host. When eggs are ingested by the primary host, the oncospheres emerge, bore into the wall of the intestine, and continue their development there. On reaching the infective stage they return to the intestine where they become sexually mature. In these cases development is completed in a single host species, the larval stage in the intestinal wall and the adult stage in the lumen. Presumably these abbreviated life cycles have arisen by the dropping out of a former intermediate host and it is possible that certain of the species in question may develop with an intermediate host as well as directly (Bacigalupo, 1931).

The life cycles which have been demonstrated are too numerous to list separately and the study dates back to the classical investigations of Leuckart, Moniez, Grassi and others. The early literature is reviewed in the monographs of Braun (1894-1900) and Joyeux (1920). More recent life cycles are described in the monograph by Fuhrmann (1931).

LITERATURE

- BACIGALUPO, J. 1931. 'Évolution de l'*Hymenolepis fraterna* Stiles chez *Pulex irritans* L., *Xenopsylla cheopis* Rothschild et *Ctenocephalus canis* Curtis.' Ann. Parasit., IX, pp. 339-343, 2 Figs.
- BRAUN, M. 1894-1900. 'Cestodes,' in H. G. Bronn's 'Klassen und Ordnungen des Thier-Reichs.,' IV, pp. 927-1731, 25 Taf.
- CALLOT, J., AND C. DESPORTES. 1934. 'Sur le cycle évolutif de *Schistocephalus solidus* (O. F. Müller).' Ann. Parasit., XII, pp. 35-39.
- DOLLFUS, R. P. 1929. 'Sur les tétrarhynques.' Bull. Soc. Zool. France, LIV, pp. 308-342.
1930. 'Sur les tétrarhynques (2^e Contribution).' Mem. Soc. Zool. France, XXIX, pp. 139-216, 53 Figs.
1935. 'Sur quelques tétrarhynques.' Bull. Soc. Zool. France, LX, pp. 353-357.
- ESSEX, H. E. 1928a. 'The structure and development of *Corallobothrium* with de-

- scriptions of two new fish tapeworms.' Ill. Biol. Monogr., XI (No. 3), 75 pp., 5 Pls.
- 1928b. 'On the life history of *Bothriocephalus cuspidatus* Cooper, 1917. A tapeworm of the wall-eyed Pike.' Trans. Amer. Micros. Soc. XLVII, pp. 348-353, 1 Pl.
1929. 'The life cycle of *Haplobothrium globuliforme* Cooper, 1914.' Sci., LXIX, pp. 677-678.
- FUHRMANN, O. 1931. 'Vermes Amera.' Cestoda, in Kükenthal und Krumbach, 'Handbuch der Zoologie,' II, pp. 257-416, Figs. 286-435.
- HUNTER, GEORGE W., 3d. 1928. 'Contributions to the life history of *Proteocephalus ambloplitis* (Leidy).' Jour. Parasit., XIV, pp. 229-242, 1 Pl.
1929. 'Life history studies on *Proteocephalus pinguis* La Rue.' Parasit., XXI, pp. 487-496, 12 Figs.
- JANICKI, C. VON, AND F. ROSEN. 1917. 'Le cycle évolutif du *Dibothriocephalus latus*. Recherches expérimentales et observations.' Bull. Soc. Neuchâtel. Sci. Nat., XLII, pp. 19-52, 2 Pls.
- JOYEUX, C. 1920. 'Cycle évolutif de quelques cestodes, recherches expérimentales.' Suppl. 2, Bull. Biol. France et Belgique, 219 pp., 7 Pls.
- JOYEUX, C., AND E. HOUEMER. 1928. 'Recherches sur la faune helminthologique de l'Indochine (Cestodes et Trématodes).' Ann. Parasit., VI, pp. 27-58, 8 Figs.
- KUCZKOWSKI, ST. 1925. 'Die Entwicklung im Genus *Ichthyotaenia* Lönnb. Ein Beitrag zur Cercomer theorie auf Grund experimenteller Untersuchungen.' Bull. Acad. polon., Cracovie, (B), pp. 423-446, Pl. XXII.
- LI, H. C. 1929. 'The life histories of *Diphyllbothrium decipiens* and *D. erinacei*.' Amer. Jour. Hyg., X, pp. 527-550, 5 Pls.
- LÖNNBERG, E. 1892. 'Einige Experimente, Cestoden künstlich lebend zu erhalten.' Centr. Bakt. Par., XI, pp. 89-92.
- MAGATH, T. B. 1929. 'The early life-history of *Crepidobothrium testudo* (Magath, 1924).' Ann. Trop. Med. Parasit., XXIII, pp. 121-128, Pl. III.
- MEGGITT, F. J. 1914. 'The structure and life history of a tapeworm. (*Ichthyotaenia filicollis* Rud.) parasitic in the stickleback.' Proc. Zool. Soc. London, I, pp. 113-138, 5 Figs., Pls. I-IV.
- ROSEN, F. 1918. 'Recherches sur le développement des cestodes, I. Le cycle évolutif des Bothriocephales.' Bull. Soc. Neuchâteloise Sci. Nat., XLIII, pp. 1-64, 3 Pls.
1919. 'Recherches sur le développement des cestodes, II. Le cycle évolutif de la *Ligula*.' Idem., XLV, pp. 1-24, 1 Pl.
- RUSZKOWSKI, J. S. 1927. 'Études sur le cycle évolutif et sur la structure des cestodes de mer I. *Echinobothrium benedeni* n. sp., ses larves et sur l'hôte intermédiaire, *Hippolyte varians* Leach.' Bull. Acad. polon. Cracovie, (B), pp. 719-738, 3 Pls.
1932. 'Études sur le cycle évolutif et la structure des cestodes de mer. III. Le cycle évolutif du tetrarhynque *Grillotia erinaceus* (van Beneden, 1858).' C. R. Acad. Cracovie, No. 9, p. 6.
- THOMAS, L. J. 1929. 'Notes on the life history of *Haplobothrium globuliforme* Cooper, a tapeworm of *Amia calva*.' Jour. Parasit., XVI, p. 107.

1931. 'Notes on the life history of *Ophiotaenia saphena* from *Rana clamitans*.' Jour. Parasit., XVII, pp. 187-195, 1 Pl.
- VOGEL, H. 1929. 'Studien zur Entwicklung von *Diphyllbothrium*. I. Teil: Die Wimperlarve von *Diphyllbothrium latum*.' Zeit. Parasit., II, pp. 213-222, 6 Figs.
1930. 'II. Teil. Die Entwicklung des Procercoids von *Diphyllbothrium latum*.' Idem, II, pp. 629-644, 8 Figs.
- WAGNER, O. 1917. 'Über Entwicklungsgang und Bau einer Fischtaenie (*Ichthyotaenia torulosa* Batsch).' Jena Zeit. Naturwiss., LV, pp. 1-66, 3 Taf., 15 Figs.
- WARDLE, R. A. 1934. 'The viability of tapeworms in artificial media.' Physiol. Zool., VII, pp. 36-62, 2 Figs.
- WISNIEWSKI, L. W. 1930. 'Das Genus *Archigetes* R. Leuck. Eine Studie zur Anatomie, Histogenese, Systematik und Biologie.' Mem. Acad. polon. Cracovie, Classe Math. Nat., (B), II, 160 pp., 8 Pls.

TREMATODA

The trematodes were classified according to adhesive organs until van Beneden (1858) divided them into two groups on the basis of life history. One group, the Monogenea, consists of species which have a direct development and infest a single vertebrate host; whereas the other, the Digenea, contains species which have an indirect, a metagenetic, or more properly an alloigenetic development, and in which the successive stages of the life cycle are harbored by two or more host species. In the Digenea sexually mature adults infest the intestine or body cavities of vertebrates, while asexual multiplication occurs in the gonads and digestive glands of various species of molluscs. Other differences were noted, viz.: the monogenetic forms are ectoparasitic and possess multiple adhesive organs, whereas the digenetic trematodes are endoparasitic and the adhesive structures consist typically of an oral sucker and an acetabulum. Thus the Monogenea comprise the polystomes and the Digenea comprise the distomes and monostomes of other authors. Nevertheless, van Beneden regarded the differences in type of development and life history as of paramount importance and subsequent investigations have abundantly confirmed his conclusion. Two seeming exceptions are undoubtedly secondary and more apparent than real; among the Digenea, members of the family Aspidogastridae are monogenetic, and among the Monogenea, the polystomes of amphibians are digenetic. It appears certain, however, that the two great groups of trematodes are only very distantly related, if indeed they have not descended from unlike turbellarian ancestors, and it is probable that the digenetic forms were parasitic in molluscs before the advent of higher vertebrates.

DIGenea

Thousands of digenetic trematodes are known by their sexually mature stages and in recent years the asexual stages have received increased attention. The first complete life history to be experimentally demonstrated was that of *Fasciola hepatica*, the liver fluke, done independently by Leuckart (1882) in Germany and by Thomas (1883) in England, which still remains the usual text book example of digenetic trematode development. It has been demonstrated repeatedly that the members of the Digenea in their development conform to a common method; migrations by primary larval forms (miracidia) transferring the parasites from vertebrate to molluscan hosts, where a series of asexual generations produce other and different larval forms (cercariae), which either directly or indirectly return again to their vertebrate hosts. For many years the identification of particular larval stages with their adult forms was difficult and slow but the last ten years especially have witnessed an outburst of successful life history studies and the addition of a wealth of new information.

Mathias (1925) described the successive stages in the life cycle of three species and listed twenty-five additional ones for which the life history had been more or less completely described. An extensive list of the literature on the Digenea is given in the excellent monograph of Fuhrmann (1928). The life cycles that had been solved in the United States previous to 1929 were listed by Stunkard (1930). In that paper he described the life cycle of *Cryptocotyle lingua*. Other life history studies done at about this time were those of Woodhead (1929) on *Bucephalus papillosus*, of Palombi (1929) on *Helicometra fasciata* Rud., of Beaver (1929) on *Allassostoma parvum* Stunkard, of Azim (1930) on *Echinostomum recurvatum*, of Palombi (1930) on *Diphtherostomum brusinae* Stossich, of Brumpt (1930) on *Schistosoma bovis*, of Van Haitsma (1930) on *Cotylurus michiganensis*, of Krull (1930) on *Pneumonoeces medioplexus* and *P. parviplexus*, of McCoy (1930) on two species of *Hamacreadium*, of Mathias (1930) on *Notocotylus attenuatus*, of Sinitzin (1930) on *Fascioloides magna*, and of Woodhead (1930) on other species of *Bucephalus*. In addition there were preliminary notices, reported in more detail later, and some partial life cycles were described.

Subsequent contributions include the life cycles of *Schistosomatium douthitti* by Price (1931), of *Cotylurus flabelliformis* and *Diplostomum flexicaudum* by Van Haitsma (1931a, 1931b), of *Bilharziella polonica* and *Apatemon gracilis* by Szidat (1931a, 1931b), of *Lepocreadium album* by Palombi (1931), of two species of *Azygia* by Szidat (1932a), of

Tracheophilus sisowi by Szidat (1932b), of *Parorchis avitus* by Stunkard and Cable (1932), of *Euparyphium murinum* by Tubangui (1932), of *Diplodiscus temperatus* by Krull and Price (1932), of *Pneumobites longiplexus* by Krull (1932), of *Brachylaemus nicolli* by Joyeux, Baer and Timon-David (1932), of *Ostiolum oxyorchis* and *Zeugorchis syntomentera* by Ingles (1933a, 1933b), of *Haematoloechus complexus*, *Halipegus occidualis* and *Gorgodera* sp. by Krull (1933a, 1933b, 1933c), of *Proterometra macrostoma* by Horsfall (1933), of *Plagitura parva* and *Cercariaeum lintoni* by Stunkard (1933a, 1933b), of three species in the subfamily Reniferinae by Talbot (1933), of *Crassiphiala ambloplitis* by Hunter (1933), of North American liver flukes by Sinitsin (1933), of *Macroderoides typicus* by McMullen (1933), of *Prohemistomum vivax* by Azim (1933), of *Euparyphium malayanum* by Rao (1933), of *Euparyphium recurvatum* by Răsin (1933), of *Euparyphium ilocanum* by Tubangui and Pasco (1933), of *Lecithodendrium chilostomum* by Brown (1933), and of *Heterophyes heterophyes* by Khalil (1933).

More recent life history studies comprise those of *Clinostomum marginatum* by Krull (1934a) and Hunter and Hunter (1934), of *Opisthorchis felineus* by Vogel (1934), of *Nephrostomum ramosum* by Azim (1934), of *Cotylophoron cotylophorum*, *Eustomos chelydrae* and *Gorgodera amplicava* by Krull (1934b, 1934c, 1934d), of *Typhlocoelum cymbium* and *Himasthla quissetensis* by Stunkard (1934a, 1934b), of *Proterometra macrostoma* by Dickerman (1934) and Horsfall (1934), of *Alaria mustelae* by Bosma (1934), of *Crepidostomum cooperi* and *Megalonia ictaluri* by Hopkins (1934), of the American species of *Paragonimus* by Ameel (1934), of *Cercorchis medius* by McMullen (1934), of *Halipegus occidualis* by Thomas and Johnson (1934), of *Brachylaemus fuscatus* by Joyeux, Baer and Timon-David (1934), of *Bacciger bacciger* by Palombi (1934), of *Panopistus pricei*, *Brachylaemus virginiana* and *Telorchis robustus* by Krull (1935a, 1935b, 1935c), of *Eustomos chelydrae* by McMullen (1935a), of *Macroderoides typicus* and *Alloglossidium corti* by McMullen (1935b), of *Sellacotyle mustelae* by Wallace (1935), of *Apharyngostrigea ibis* and *Lepoderma ramliianum* by Azim (1935a, 1935b), of *Notocotylus urbanensis* by Luttermoser (1935), and of *Renifer aniarum* and *Dasymetra villicaeca* by Byrd (1935).

Several of the references listed are abstracts of research, and others are complete papers which supplement earlier preliminary reports. The longer papers contain bibliographies in which additional citations may be found.

LITERATURE

- AMEEL, D. J. 1934. '*Paragonimus*, its life history and distribution in North America and its taxonomy (Trematoda: Troglotremitidae).' Amer. Jour. Hyg., XIX, pp. 279-318, Pls. i-vi.
- AZIM, M. A. 1930. 'On the identification and life history of *Echinostomum recurvatum* von Linstow, 1873.' Ann. Trop. Med. Parasit., XXIV, pp. 189-192, Pl. iii.
1933. 'On *Prohemistomum vivax* (Sonsino, 1892) and its development from *Cercaria vivax*, Sonsino, 1892.' Zeit. Parasit., V, pp. 432-436, 6 Figs.
1934. 'On the life history of *Nephrostomum ramosum* Sonsino, 1895.' Ann. Mag. Nat. Hist., XIV, pp. 154-157, 1 Pl.
- 1935a. 'Entwicklungsgeschichte von *Apharyngostrigea ibis* n. sp. und seine Entwicklung aus *Cercaria Apharyngostrigea ibis* n. sp. in dem Reihher, *Ardeola ibis ibis*.' Zeit. Parasit., VII, pp. 608-615, 11 Figs.
- 1935b. 'On the life history of *Lepoderma ramlium* Looss, 1896, and its development from a *Xiphidiocercaria*.' Jour. Parasit., XXI, pp. 365-368, 8 Figs.
- BEAVER, P. C. 1929. 'Studies on the development of *Allasostoma parvum* Stunkard.' Jour. Parasit., XVI, pp. 13-24, 1 Fig., Pl. ii.
- BENEDEN, P. J. VAN. 1858. 'Mémoire sur les vers intestinaux.' Paris.
- BOSMA, N. J. 1934. 'The life history of the trematode, *Alaria mustelae*, Bosma, 1931.' Trans. Amer. Micr. Soc., LIII, pp. 116-153, Pls. viii-x.
- BROWN, F. J. 1933. 'On the excretory system and life history of *Lecithodendrium chilostomum* (Mehl.) and other bat trematodes, with a note on the life history of *Dicrocoelum dendriticum* (Rudolphi).' Parasit., XXV, pp. 317-328, 1 Fig., Pl. xxi.
- BRUMPT, E. 1930. 'Cycle évolutif complet de *Schistosoma bovis*. Infection naturelle en Corse et infection expérimentale de *Bullinus contortus*.' Ann. Parasit., VIII, pp. 17-50, 17 Figs.
- BYRD, E. E. 1935. 'Life history studies of Reniferinae (Trematoda, Digenea) parasitic in Reptilia of the New Orleans Area.' Trans. Amer. Micr. Soc., LIV, pp. 196-225, Pls. xxxii-xxxvi.
- DICKERMAN, E. E. 1934. 'Studies on the trematode family Azygiidae. I. The morphology and life cycle of *Proterometra macrostoma* Horsfall.' Trans. Amer. Micr. Soc., LIII, pp. 8-22, Pl. ii.
- FUHRMANN, O. 1928. 'Trematoda. Zweite Klasse des Cladus Plathelminthes.' in Kükenthal und Krumbach, 'Handbuch der Zoologie,' II (2), pp. 1-128, 171 Figs.
- HOPKINS, S. H. 1934. 'The Papillous Allocreadiidae. A study of their morphology, life histories, and relationships.' Ill. Biol. Monogr., XIII (No. 2), 80 pp., Pls. i-iv.
- HORSFALL, M. W. 1933. 'Development of *Cercaria macrostoma* Faust into *Proterometra* (nov. gen.) *macrostoma*.' Science, LXXVIII, pp. 175-176.
1934. 'Studies on the life history and morphology of the cystocercous cercariae.' Trans. Amer. Micr. Soc., LIII, pp. 311-348, Pls. xxxviii-xxxix.
- HUNTER, GEORGE W., 3d. 1933. 'The Strigeid trematode, *Crassiphiala ambloplitis* (Hughes, 1927).' Parasit., XXV, pp. 510-517, 6 Figs.

- HUNTER, GEORGE W., 3d, AND W. S. HUNTER. 1934. 'The life cycle of the yellow grub of fish.' Jour. Parasit., XX, p. 325.
- INGLES, L. G. 1933a. 'Studies on the structure and life history of *Ostiolium oxyorchis* (Ingles) from the California red-legged frog *Rana aurora draytoni*.' Univ. Cal. Pub. Zool., XXXIX, pp. 135-161, Pls. VI-XII, 1 Fig.
- 1933b. 'Studies on the structure and life history of *Zeugorchis syntomentera* Sumwalt, a trematode from the snake *Thamnophis ordinoides* from California.' Idem, XXXIX, pp. 163-177, Pl. XIII.
- JOYEUX, C., J.-G. BAER, AND J. TIMON-DAVID. 1932. 'Le développement du trématode *Brachylaemus* (*Brachylaemus nicolli*) (Witenberg).' C. R. Soc. Biol., CIX, pp. 464-466.
1934. 'Recherches sur les Trématodes du genre *Brachylaemus* Dujardin (syn. *Harmostomum* Braun).' Bull. Biol. France and Belgique, LXVIII: 385-418, 7 Figs. and Pl. XIV.
- KHALIL, M. 1933. 'The life history of the human trematode parasite *Heterophyes heterophyes* in Egypt.' Lancet, CCXXV, p. 537.
- KRULL, W. H. 1930. 'The life history of two North American frog lung flukes.' Jour. Parasit., XVI, pp. 207-212, 1 Fig.
1932. Studies on the life history of *Pneumobites longiplexus* (Stafford). Zool. Anz., KCIX, pp. 231-239, 2 Figs.
- 1933a. 'Studies on the life history of a frog lung fluke, *Haematoloechus complexus* (Seely, 1906) Krull N. comb.' Zeit. Parasit., VI, pp. 192-207, 9 Figs.
- 1933b. 'Notes on the life history of *Halipegus occidialis* (Stafford, 1905) in the green frog, *Rana clamitans*.' Jour. Parasit., XX, pp. 133-134.
- 1933c. 'Notes on the life history of a frog bladder fluke.' Jour. Parasit., XX, p. 134.
- 1934a. 'Some observations on the cercaria and redia of a species of *Clinostomum*, apparently *C. marginatum* (Rudolphi, 1879) (Trematoda: Clinostomidae).' Proc. Helminth. Soc. Wash., I, pp. 34-35, Fig. 10.
- 1934b. 'Life history studies on *Cotylophoron cotylophorum* (Fischöeder, 1901) Stiles and Goldberger, 1910.' Jour. Parasit., XX, pp. 173-180.
- 1934c. 'A note on the life history of a trematode, *Eustomos chelydrae* MacCallum, 1921.' Jour. Parasit., XX, p. 326.
- 1934d. 'Studies on the life history of a frog bladder fluke, *Gorgodera ampli-cava* Looss, 1899.' Papers Mich. Acad. Sci., XX, pp. 697-710, Pl. CIX.
- 1935a. 'Studies on the life history of *Panopistus pricei* Sinitsin, 1931. (Trematoda).' Parasit., XXVII, pp. 93-101, 1 Pl.
- 1935b. 'Some observations on the life history of *Brachylaemus virginiana* (Dickerson) Krull N. 1934.' Trans. Amer. Micr. Soc., LIV, pp. 118-135, Pl. XXIV.
- 1935c. 'A note on the life history of *Telorchis robustus* Goldb. (Trematoda: Telorchidae).' Proc. Helminth. Soc. Wash., II, p. 65.
- KRULL, W. H., AND H. F. PRICE. 1932. 'Studies on the life history of *Diplo-discus*

- temperatus* Stafford from the frog.' Occ. Pap. Mus. Zool. Univ. Mich., No. 237, 38 pp., 2 Pls.
- LEUCKART, R. 1882. 'Zur Entwicklungsgeschichte des Leberegels (*Dist. hepaticum*).' Arch. Naturg., XLVIII J., 1, pp. 80-119, Pl. VIII.
- LUTTERMOSER, G. W. 1935. 'A note on the life history of the monostome, *Notocotylus urbanensis*.' Jour. Parasit., XXI, p. 456.
- MATHIAS, P. 1925. 'Recherches expérimentales sur le cycle évolutif de quelques Trématodes.' Bull. Biol. France et Belg., LIX, pp. 1-123, 4 Pls.
1930. 'Sur le cycle évolutif d'un Trématode de la famille des Notocotylidae Lühe (*Notocotylus attenuatus* Rud.).' C. R. Acad. Sci., Paris, CXCI, pp. 75-77.
- MCCOY, O. 1930. 'Experimental studies on two fish trematodes of the genus *Hamacreadium* (Family Allocreadiidae).' Jour. Parasit., XVII, pp. 1-13, 3 Figs.
- McMULLEN, D. B. 1933. 'Life history of *Macroderoides typicus*.' Jour. Parasit., XX, p. 135.
1934. 'The life cycle of the turtle trematode, *Cercorchis medius*.' Jour. Parasit., XX, pp. 248-250.
- 1935a. 'The life cycle and a discussion of the systematics of the turtle trematode *Eustomos chelydrae*.' Jour. Parasit., XXI, pp. 52-53, 2 Figs.
- 1935b. 'The life histories and classification of two allocreadiid-like plagiorchids from fish, *Macroderoides typicus* (Winfield) and *Alloglossidium corti* (Lamont).' Jour. Parasit., XXI, pp. 369-380, 14 Figs.
- PALOMBI, A. 1929. 'Ricerce sul ciclo evolutivo di *Helicometra fasciata* (Rud.).' Pubbl. Staz. Zool. Napoli, IX, pp. 237-292, 33 Figs., Pl. x.
1930. 'Il ciclo biologico di *Diphtherostomum bruninae* Stossich (Trematode digeneticco: fam. Zoogonidae Odhner). Considerazioni sui cicli evolutivi delle specie affini e dei trematodi in generale.' Idem, X, pp. 111-149, 24 Figs., 1 Pl.
1931. 'Rapporti genetici tra *Lepocreadium album* Stossich e *Cercaria setifera* (non Joh. Müller) Monticelli.' Boll. Zool. Napoli, II, pp. 165-171, 2 Figs.
1934. '*Bacciger bacciger* (Rud.). Trematode digeneticco: fam. Steringophoridae Odhner.' Pubbl. Staz. Zool. Napoli, XIII, pp. 438-478, 33 Figs.
- PRICE, H. F. 1931. 'Life-history of *Schistosomatum douthitti* (Cort).' Amer. Jour. Hyg., XIII, pp. 685-727, Pl. I-IV.
- RAO, A. N. 1933. 'A preliminary report on the adult trematode obtained from *Cercaria indicae* XXIII Sewell, 1922.' Ind. Jour. Vet. Sci., III, pp. 316-320, 1 Pl., 3 Figs.
- RÄSÄN, K. 1933. '*Echinoparyphium recurvatum* (Linstow, 1873) und seine Entwicklung.' Biol. Spisy Ecole Veterin. Brno, XII, pp. 1-98, 47 Figs.
- SINITSEV, D. F. 1930. 'A note on the life history of the large American fluke, *Fasciola magna* (Bassi).' Science, LXXII, pp. 273-274.
1933. 'Studien über die Phylogenie der Trematodes VI. The life histories of some American liver flukes.' Zeit. Parasit., VI, pp. 170-191, 23 Figs.

- STUNKARD, H. W. 1930. 'The life history of *Cryptocotyle lingua*, with notes on the physiology of the metacercariae.' Jour. Morph., L, pp. 143-191, Pls. I-IV.
- 1933a. 'The life-cycle of *Plagitura parva*.' Jour. Parasit., XX, p. 135.
- 1933b. 'Further observations on the life cycle of *Cercariaeum lintoni*.' Anat. Rec., LVII (Suppl.), p. 99.
- 1934a. 'The life history of *Typhlocoelum cymbium* (Diesing, 1850) Kossack, 1911, (Trematoda, Cyclocoelidae). Bull. Soc. Zool. France, LIX, pp. 447-466, 2 Pls., 1 Fig.
- 1934b. 'The life history of *Himastha quissetensis* (Miller and Northup, 1926). Jour. Parasit., XX, p. 336.
- STUNKARD, H. W., AND R. M. CABLE. 1932. 'The life history of *Parorchis avitus* (Linton), a trematode from the cloaca of the gull.' Biol. Bull., LXII, pp. 328-338, 1 Pl.
- SZIDAT, L. 1931a. 'Die Lebensgeschichte von *Bilharziella polonica* Kow., ein Beispiel für die Entwicklung eines Blutrematoden.' Verh. Ges. deuts. Naturf., Arzt, XCI, pp. 1055-1056.
- 1931b. 'Beiträge zur Entwicklungsgeschichte der Holostomiden IV. Die Cercarie des Entenparasiten *Apatemon* (*Strigea*) *gracilis* Rud. und ihre Entwicklung im Blutgefäßsystem des Zwischenwirtes (*Herpobdella aiomaria* Car.).' Zeit. Parasit., III, pp. 160-172, 13 Figs.
- 1932a. 'Über cysticerke Riesencercarien, insbesondere *Cercaria mirabilis* M. Braun und *Cercaria splendens* n. sp. und ihre Entwicklung im Magen von Raubfischen zu Trematoden der Gattung *Azygia* Looss.' Zeit. Parasit., IV, pp. 477-505, 22 Figs.
- 1932b. 'Zur Entwicklungsgeschichte der Cyclocoeliden. Der Lebenszyklus von *Tracheophilus sisowi* Skrj., 1923.' Zool. Anz., C, pp. 205-213, 3 Figs.
- TALBOT, S. B. 1933. 'Life history studies on trematodes of the subfamily Reniferinae.' Parasit., XXV, pp. 518-545, 24 Figs.
- THOMAS, A. P. W. 1883. 'The life history of the liver fluke (*Fasciola hepatica*).' Quart. Jour. Micr. Sci., XXIII, pp. 99-133, Pls. II-III.
- THOMAS, L. J., AND A. D. JOHNSON. 1934. 'Experiments and observations on the life cycle of *Halipegus occidualis* (Stafford, 1905).' Jour. Parasit., XX, p. 327.
- TUBANGUI, M. A. 1932. 'Observations on the life histories of *Euparyphium murinum* Tubangui, 1931, and *Echinostomum revolutum* (Froelich, 1802) (Trematoda).' Phil. Jour. Sci., XLVII, pp. 497-511, 3 Pls.
- TUBANGUI, M. A., AND A. M. PASCO. 1933. 'The life history of the human intestinal fluke, *Euparyphium ilocanum*.' Idem, LI, pp. 581-606, 4 Pls.
- VAN HAITSMA, J. P. 1930. 'Studies on the trematode family Strigeidae (Holostomidae) XXI. Life cycle and description of the cercaria of *Cotylurus michiganensis* (La Rue).' Jour. Parasit., XVI, pp. 224-230, 3 Figs.
- 1931a. 'Studies on the trematode family Strigeidae (Holostomidae) No. XXII: *Cotylurus flabelliformis* (Faust) and its life history.' Papers Mich. Acad. Sci., XIII, pp. 447-482, Pls. XLI-XLII.
- 1931b. 'Studies on the trematode family Strigeidae (Holostomidae) No.

- XXIII: *Diplostomum flexicaudum* (Cort and Brooks) and stages in its life history.' Idem, XIII, pp. 483-516, Pl. XLIII-XLV.
- VOGEL, H. 1934. 'Der Entwicklungszyklus von *Opisthorchis felineus* (Riv.) nebst Bemerkungen über die Systematik und Epidemiologie.' *Zoologica*, XXXIII, 103 pp., 8 Pls., 45 Figs.
- WALLACE, F. G. 1935. 'A morphological and biological study of the trematode, *Sellacotyle mustelae*, n. g., n. sp.' *Jour. Parasit.*, XXI, pp. 143-164, 2 Pls., 15 Figs.
- WOODHEAD, A. 1929. 'Life history studies on the trematode family Bucephalidae.' *Trans. Amer. Micr. Soc.*, XLVIII, pp. 256-275, Pl. xxxi.
1930. 'Life history studies on the trematode family Bucephalidae II.' Idem, XLIX, pp. 1-17, Pls. i-ii.

MONOGENEA

The monogenetic trematodes occur frequently on the gills and skin of both marine and fresh-water fishes, and occasionally cause fatal epidemics among young fishes. Species have been found also in the oronasal cavities and urinary bladder of turtles, in the urinary bladder and on the skin of amphibians, and on marine crustaceans and cephalopods.

Studies on the life history of the monogenetic trematodes date from the papers of Zeller (1872a, 1872b, 1876) but few developmental cycles have been completely traced. The work of Gallien (1935) has confirmed the earlier account of Zeller on *P. integerrimum* and showed an alternation of generations in this species. Other life cycles traced experimentally are those of *Gyrodactylus elegans* by Kathariner (1904), of two species of *Dactylogyrus* by Kulwiec (1927), of *Ancyrocephalus vistulensis* by Siwak (1932), of *Epididella melleni* by Jahn and Kuhn (1932), and that of *Sphyrnura oligorchis* by Alvey (1933).

LITERATURE

- ALVEY, C. H. 1933. 'The life-cycle of *Sphyrnura oligorchis*.' *Jour. Parasit.*, XX, p. 140.
- GALLIEN, L. 1935. 'Sur le dimorphisme évolutif et la biologie de *Polystomum integerrimum* Fröhl.' *Trav. Station Zool. Wimereux*, XII, 181 pp., Pls. I-IV.
- JAHN, T. L., AND L. R. KUHN. 1932. 'The life history of *Epididella melleni* MacCallum, 1927, a monogenetic trematode parasitic on marine fishes.' *Biol. Bull.*, LXII, pp. 89-111, 2 Pls., 2 Figs.
- KATHARINER, L. 1904. 'Ueber die Entwicklung von *Gyrodactylus elegans* v. Nordm.' *Zool. Jahrb. Suppl.*, VII, pp. 519-550, 3 Pls.
- KULWIEC, Z. 1927. 'Untersuchungen an Arten des Genus *Dactylogyrus* Diesing.' *Bull. Acad. Polon. Cracovie*, (B), pp. 113-144, Pls. xx-xxi, 13 Figs.

- SIWAK, J. 1932. '*Ancyrocephalus vistulensis* sp. n., un nouveau trématode, parasite du Silure (*Silurus glanis* L.).' Idem, II, pp. 669-679, Pl. XLII, 7 Figs.
- ZELLER, E. 1872a. 'Untersuchungen über die Entwicklung und den Bau des *Polystomum integerrimum* Rud.' Zeit. wiss. Zool., XXII, pp. 1-28, 2 Pls.
- 1872b. 'Untersuchungen über die Entwicklung des *Diplozoon paradoxum*.' Idem, XXII, pp. 168-180, Pl. XII.
1876. 'Weiterer Beitrag zur Kenntniss der Polystomen.' Idem, XXVII, pp. 238-275, 2 Pls.

SUMMARY AND CONCLUSIONS

The conventional method of dealing with the phylum Platyhelminthes, as employed in text books and treatises on zoölogy, is to discuss the Turbellaria, the Trematoda and the Cestoda in that order, with little or no consideration of the Mesozoa as related organisms. Such a method begins with a discussion of typical free living worms and proceeds through a series of forms showing increasingly adaptive modifications, but it gives little idea of the true relationships, of the time factor concerned, or of the effects of parasitism upon these animals.

From a consideration of the bionomics, life cycles and development of the flatworms, it seems possible to formulate a more adequate and comprehensive concept of the group. The general effects of parasitism must be recognized in a consideration of those groups in which it has become established. There is common agreement that it results in adaptive morphological changes and that eventually it may lead to the acquisition of new and accessory types of reproduction. With these guiding principles in mind, a study of the cleavage, development and morphology of the several groups of flatworms may lead to certain definite conclusions. In those forms in which free living larval stages have been retained it is possible to make direct comparisons of early development, while in many of the cestodes the modifications have in large measure eliminated this method of approach. Other evidence, however, may be utilized in an analysis of the problem and homologous structures give unmistakable clues. In the Handbuch der Zoologie, vol. I, p. 48, Bresslau and Reisinger have presented a clear and convincing argument for the descent of the Platyhelminthes from planula-like ancestors. Their conclusions concerning the relationships between the ctenophores, nemertines and euplathyhelminths are logical and present a natural arrangement of the groups. They state further, p. 50.

"Innerhalb der *Euplathelminthen-Reihe* spricht alles für die Ursprüng-

lichkeit der *Acoela*. Ihnen schliessen sich unmittelbar die *Microstomidae* unter den *hysterophoren Rhabdocoelen* und die *Allocoele Hofstenia* an. Wie sich die *übrigen Turbellarien* daran anreihen, wird bei der Besprechung der Klasse selbst näher ausgeführt werden. Hier sei nur bemerkt, dass über die *Alloecoelen* eine schöne Stufenfolge zu den *Tricladen* führt. Die *Polycladen* zeigen in ihrem Gonadenbau noch so ursprüngliche Verhältnisse (Ovarien.), dass wohl nur ein Anschluss an sehr primitive Formen in Betracht kommt. Unter den *Rhabdocoelen* verdienen die Familien der *Graffilliden* und *Anoplodiiden* besonderes Interesse, insofern als von ihnen aus vermutlich die Entwicklung der *Trematoden* ihren Ausgang genommen hat. Nach ihrer ganzen Organisation sind die *Monogenea* wahrscheinlich von *Graffilliden*, die *Digenea* von *Anoplodiiden* oder *anoplodiiden-ähnlichen Kalyptorhynchiern* (*Rhabdocoela*) herzuleiten. Gut stimmt damit überein, dass gerade diese Familien das Hauptkontingent an Parasiten unter den Strudelwürmern stellen. Auch die *Temnocephalen* schliessen sich nahe an diese zu parasitischem Leben neigenden *Rhabdocoelen-Familien* an. Die *Cestodarien* und *Cestoden* stammen ihrerseits vielleicht von *Trematoden* ab; da aber das Rostellum der *Bandwürmer* wahrscheinlich dem Rüssel der *Rhabdocoela Kalyptorhynchia* homolog ist, kann auch daran gedacht werden, die *Cestoden* unmittelbar von *turbellarienartigen* Vorfahren herzuleiten."

The selection and treatment of data by Bresslau and Reisinger are highly commendable and their conclusions are very interesting. Many of them will doubtless be accepted as correct, but the origin of the *Digenea* from the *Anoplodiidae* appears to disregard the extent of modification among the *digenetic trematodes*. The suggestion that the *Cestoidae* may have originated from the *trematodes* is subject to the same objection. Furthermore, the derivation of a great group like the *cestodes* from another already highly specialized parasitic one does not commend itself as probable. The *Digenea* and *Cestoda* comprise groups too large, too diverse, and too complex to be satisfactorily derived from a single, existing, *turbellarian* family.

The *Turbellaria* have in the main remained free living and consequently they may be expected to resemble the primitive ancestral form of the *Platyhelminthes*. They are chiefly carnivorous in habit, but as a result of their small size, defenseless condition and negative heliotropism, they secrete themselves in small recesses and often in or on the bodies of larger organisms. From these retreats they make predacious excursions or they may derive food from the secretions of their temporary hosts.

Such a mode of life encourages and facilitates the development of the parasitic habit and in fact the majority of the flatworms have adopted it. These worms demonstrate the course and successive stages of parasitic adaptation and no other phylum presents such a continuous and complete transition from free living existence to parasitism. Throughout their entire history these animals have been forced to conceal themselves and the same influences have been operative more or less continuously. The extensive and pronounced degeneration of some of them indicates the long period in which they have been parasitic. From the evidence at hand it is almost certain that members of the phylum became parasites of invertebrates in early geologic time and it is probable that the Mesozoa are surviving representatives of that early association. It is also probable that the cestodes and digenetic trematodes are survivors from that period, which have later added vertebrate hosts in their life cycles and have become biologically more successful. In later periods other commensal and parasitic groups have arisen, e.g., the Temnocephala which occur chiefly on fresh-water invertebrates and the Monogenea which occur chiefly on marine vertebrates. Accordingly it appears that the Turbellaria, Mesozoa, Cestoda and Digenea have descended concomitantly from a common ancestral group of planula-like ancestors.

A phylogenetic determination must take cognizance of all available information, and a survey of the data from the bionomics, development and morphology has led to the concept advanced in this paper. From a hypothetical, generalized, planula-like ancestor it is possible to derive each of the existing groups of the phylum Platyhelminthes. Comparison of the primitive form with representatives of the Mesozoa shows many resemblances, and if allowance for a long period of parasitism is made, the agreement is remarkable. Moreover, the miracidia of the Digenea and ciliated larvae of the Monogenea can be compared with the ancestral type. In all these groups there is a similarity in cleavage and early developmental stages which clearly denotes genetic relationships. The idea presented appears to be the most natural, logical and satisfactory interpretation of available data.

AMERICAN MUSEUM NOVITATES

Number 909

Published by
THE AMERICAN MUSEUM OF NATURAL HISTORY February 25, 1937
New York City

BEES OF THE GENUS *SPHECODES* FROM SASKATCHEWAN

By T. D. A. COCKERELL

On August 30, 1936, I went out to hunt bees at Waskesiu, in Prince Albert National Park, Saskatchewan. The locality is in the Canadian Zone. It was late in the season for a place so far north, and it seemed at first that I should not get anything. The many fine asters by the roadsides had no bees upon them. I had almost concluded that there was nothing to be had, except an occasional stray *Bombus*, when I chanced on some small patches of golden rod near the shore of the lake. These were freely visited by small bees, mostly *Sphecodes*, but with also a male *Halictus* (*Chloralictus*) *oblongus* Lovell and a female *Andrena canadensis* Dalla Torre. A male *Halictus lerouxii* Lepeletier was taken nearby, but not on a flower. The *Sphecodes*, on examination, proved to consist of four species, apparently all new. Professor E. H. Strickland has sent me 29 specimens of *Sphecodes* from the adjacent province of Alberta. Two species are represented by males, both different from any of the Waskesiu species. There are at least ten species represented by females. Graenicher records thirteen species from Wisconsin, all different from the Waskesiu ones. In southern Maine, Lovell found about eight species. A *Sphecodes nubilus* Lovell and Cockerell has been cited, without description, by Lovell, Johnson and Meyer; I do not know the source of the name, possibly it is the species described as *S. nephelotus* Lovell and Cockerell.

Southward, from Illinois to Colorado and New Mexico, the *Sphecode* fauna is much more varied, with genera or subgenera segregated by Robertson: *Drepanium*, *Dialonia* and *Machaeris*, having simple mandibles in the female; *Proteraner*, with males appearing in the spring; *Sphecodium*, small species in which the fourth antennal joint of male is hardly longer than the third. Singularly enough, there is a genus *Eupetersia* Blüthgen (1928) in Africa, with fourteen species, which is doubtfully distinct from *Machaeris* (see Ann. Mag. Nat. Hist., July, 1932, p. 118). In Central Europe, the *Sphecodes* fauna is rich, with 22 species. Timberlake has found many species, which still await description, in Southern California.

Most species of *Sphecodes* are parasitic in nests of *Halictus*, but some

(as *S. pellucidus* Smith) live with *Andrena*. According to the European records, they do not confine themselves to a single species of the host genus. We know hardly anything about the biology of American *Sphecodes*.

***Sphecodes solidaginis*, new species**

MALE.—Length about 7.3 mm., anterior wing about 5; head and thorax black, with white hair, dull and thin on thorax, but dense and pure white at sides of face, the clypeus hairy in middle, but a large triangular patch on each side bare enough to show the surface, which is dull, very densely and strongly punctured; antennae black (flagellum very faintly brownish beneath toward end), third joint about 170 μ long, fourth 290; flagellum moniliform, the joints with small facets; mandibles bright red except at base; mesothorax densely and coarsely punctured, shining between the punctures; scutellum densely and coarsely punctured; area of metathorax large, semicircular, with very coarse plicae, which at base are replaced by a rugose surface, and near apex are crossed by a ridge; tegulae brown with a broad hyaline margin; wings clear hyaline, stigma and nervures pale yellowish brown; second cubital cell broad, but not as broad as high, receiving recurrent nervure near end; seven hooks on hind wing; legs black, with the anterior tibiae red in front, and the tarsi dusky reddish or brownish, not conspicuously pale; spurs yellowish white; abdomen highly polished, first two tergites entirely orange-ferruginous, first with very sparse punctures, second with numerous punctures on basal part, but apical depression impunctate; third tergite red, with a suffused black saddle, not nearly reaching sides, and the broad apical margin pale golden; fourth and fifth black, sixth dusky red; first two sternites red, the others black; genitalia entirely clear bright ferruginous; apical joint of stipites claw-like, basal part stout; sagittae short, dark at end.

Variety *b*.—Mandibles with less red, the basal half black; third antennal joint about 200 μ , fourth about 270; anterior tibiae entirely black; first tergite broadly suffused with black, leaving a large triangular red area at each apical corner; second tergite with a black saddle; third black; first sternite red, the others black.

Waskesiu, Saskatchewan, at flowers of *Solidago*, Aug. 30, 1936 (Cockerell). This may be compared with the next species, but I do not know any other with entirely bright red genitalia.

***Sphecodes borealis*, new species**

MALE.—Length about 7.5 mm., anterior wing 5.5 mm.; head and thorax black, with white hair, dull and sparse on thorax, dense and pure white on face, covering surface; mandibles bright red, with the base black; antennae black, third joint about 200 μ long, fourth about 320; flagellum moniliform, facets beginning on eighth antennal joint, and reaching base of joint; mesothorax and scutellum densely punctured, shining between the punctures; area of metathorax poorly defined, with very coarse irregular rugae, at sides forming an open reticulation; tegulae dark brown, with pallid margin; wings clear hyaline; stigma dark reddish brown, nervures pale brown; second cubital cell moderately broad, the lower side very oblique; seven hooks on hind wing; legs black, with the front knees, the anterior tibiae in front,

the other tibiae at end, and the tarsi, red; abdomen highly polished, first two tergites entirely bright chestnut red; sculpture of first two tergites about as in *S. solidaginis*; third tergite black in middle and red at sides; the remaining tergites black; first three sternites red, but first and third with a black spot in middle; genitalia formed much as in *S. solidaginis*, but black, with the falciform apical part of stipites red, the basal part of stipites extremely stout.

Waskesiu, Saskatchewan, at flowers of *Solidago*, Aug. 30, 1936 (Cockerell). *S. patruelis* Cockerell, from Washington State, has the extremely stout basal part of stipites black, but the short subglobose apical part, and the sagittae, bright red. It is considerably smaller than *S. borealis*, and has the tarsi yellowish white, and the tibiae light reddish at apex.

Sphecodes pusillus, new species

MALE.—Length about 6 mm., anterior wing 4 mm.; head and thorax black, with very little hair, but the broad face covered with white hair, not so dense as to hide the well-punctured surface of clypeus, the hairs on clypeus conspicuously plumose; mandibles black, with the tip bright red; antennae black, the stout flagellum long; third joint about 120 μ long, fourth about 255; large subquadrate granular minutely pubescent areas, appearing pallid, on last six antennal joints, these areas including the base but not reaching apex; mesothorax and scutellum polished, the punctures not very dense; area of metathorax semicircular, distinct, very coarsely reticulate; tegulae light brown; wings grayish hyaline, stigma and nervures brown; second cubital cell very narrow; legs black, with the tarsi dull whitish, the short thick front tibiae shining and obscure reddish on inner side; hind tibiae black to the end; abdomen polished, rather broad and short for a male; punctures on first tergite sparse but fairly abundant, on second about as in the species described above; first two tergites red, the first with a black area in middle, and a pair (more basad) at sides, second with an inconspicuous blackish spot in middle; remaining tergites black, except that the third has the basal corners red; first two sternites red. The type has six hooks on hind wing on one side, seven on the other.

Waskesiu, Saskatchewan, at flowers of *Solidago*, Aug. 30, 1936 (Cockerell). This may be compared with *S. nephelotus* Lovell and Cockerell, from Maine, which differs by having the abdomen black, with two or three red bands, and the clear, milky wings.

Sphecodes politulus, new species

MALE.—Length about 6.5 mm., anterior wing 4.5 mm.; head and thorax black, with scanty white hair, the face densely covered with white hair; mandibles bright red except at base; antennae black, the flagellum not moniliform, obscurely brown beneath; mesothorax and scutellum highly polished and sparsely punctured; area of metathorax rather short, very coarsely reticulate; posterior truncation very coarsely rugose; tegulae very dark; wings brownish hyaline, stigma and nervures brown; second cubital cell moderately broad, third broader on marginal than second; five hooks on hind wing; legs black, with the tarsi, front tibiae except a blackened

area on outer side, and narrow apex of middle and hind tibiae, red; abdomen highly polished, the first tergite black, with the hind margin broadly red; second all red; third red with a nebulous transverse black shade, the rest black; first three sternites red. The antennae have the third joint about 135μ long, the fourth about 255 ; a noteworthy feature is a large strongly punctured area, apically rounded, on fourth segment, its base resting on the base of the segment. The first tergite is impunctate, and the second has only widely scattered excessively minute punctures; thus the species differs from those described above.

Waskesiu, Saskatchewan, at flowers of *Solidago*, Aug. 30 (Cockerell).

In many ways this closely resembles *S. millsii* Cockerell, from the mountains of Colorado, but it is a little smaller, has dusky wings, and no black on second tergite.

The only other *Sphécodes* I took in Saskatchewan was a male *S. lautipennis* Cockerell, at flowers of *Solidago*, Saskatoon, Sept. 6. This is a species of the prairie region, not likely to occur at Waskesiu.

The following key will separate the above males. I include also a Wisconsin species (*S. solonis*), because the Wisconsin fauna extends in large measure to western Canada, as shown especially in the genus *Andrena*.

- 1.—Length nearly 6 mm.; abdomen black, except testaceous bands on first three tergites.....*solonis* Graenicher.
Abdomen with some of the tergites red..... 2.
- 2.—Over 7 mm. long; fourth antennal joint not twice as long as third; antennae entirely black; wings perfectly clear..... 3.
Less than 7 mm. long; fourth antennal joint about twice as long as third; wings more or less brownish or dusky..... 6.
- 3.—First tergite mainly or partly black..... 4.
First tergite entirely clear red..... 5.
- 4.—Larger; tergites 2 and 3 entirely clear red; wings milky.. *lautipennis* Cockerell.
Smaller; second tergite with a black saddle... *solidaginis*, new species, variety b.
- 5.—Genitalia entirely clear red..... *solidaginis*, new species.
Genitalia mainly black..... *borealis*, new species.
- 6.—First tergite mainly red; antennae black; tarsi whitish... *pusillus*, new species.
First tergite mainly black, broadly red at sides posteriorly; tarsi clear red.
politulus, new species.

S. hudsoni Cockerell was based on the female, about 7 mm. long, from Hudson Bay. It does not seem likely to belong with any of the above males, and I do not find it among the females from Alberta. The abdomen is entirely clear yellowish ferruginous, and the legs are dark rufous.

The types of the new species have been placed in the American Museum.

AMERICAN MUSEUM NOVITATES

Number 910

Published by
THE AMERICAN MUSEUM OF NATURAL HISTORY
New York City

February 25, 1937

A NEW BEE FROM CHILE

By T. D. A. COCKERELL

Augochlora (Oxystoglossa) angolensis, new species

FEMALE.—Length about 8 mm., anterior wing 6.5 mm.; robust, bright green, the head emerald green, the dull mesothorax yellowish green, the convex scutellum shining emerald green, thorax posteriorly and at sides (including postscutellum) bluer green, but broad shining hind margin of area of metathorax emerald green; abdomen bluish green, rather dull, the first tergite yellower green; legs black, the hind coxae and femora greenish beneath; hair of head and thorax dull white, faintly yellowish dorsally; head broad; inner orbits with no distinct emargination; mandibles and labrum black, the latter with long hairs; clypeus very short, its margin thickened and broadly black; supraclypeal area very large, shining, but sides of face dull; flagellum dull ferruginous beneath; tubercles projecting but obtuse, shining blue-green; mesothorax entirely dull, the median groove distinct; scutellum minutely lineolate, with scattered very weak punctures; area of metathorax dull except margin, with a microscopically lineolate surface; posterior truncation not sharply bounded at sides; tegulae very dark brown; wings grayish hyaline, stigma and nervures very dark brown; second cubital cell nearly as broad on marginal as third, receiving recurrent nervure not far from end; legs with copious pale hair, a little reddish on inner side of hind tarsi; hind spur not pectinate; tergites not vibrissate, they have an extremely narrow blackish edge, but are not really black margined, but the shining bases of the tergites following (normally covered) are black; venter partly black and partly yellowish green.

Chile: Angol, Oct. 14, 1928 (D. S. Bullock). Given to me by Mr. Maurice James. The type has been placed in the American Museum. At Angol were also found *Bombus dahlbomii* Guérin, *Centris cineraria* Smith, *Megachile pollinosa* Spinola, *Policana occidentalis* (Haliday), *Diphaglossa gayi* Spinola, *Caupolicana herbsti* Friese and *C. gayi* Spinola.

This species may be compared with other similar-looking ones as follows:

- 1.—Area of metathorax glistening, with very distinct striae.....2.
Area of metathorax without evident striae.....4.
- 2.—First two tergites vibrissate, with yellow hairs.....*diversipennis* (Lepelletier).
First two tergites not vibrissate.....3.
- 3.—Larger; hind margins of tergites black; inner orbits strongly emarginate.
nigromarginata (Spinola).
Smaller; hind margins of tergites green (Mendoza, Argentine)..*argentina* Friese.

- 4.—Mesothorax and area of metathorax shining; scutellum highly polished. (Chile).
chloris (Spinola).

Mesothorax dull; area of metathorax dull or granular except margin..... 5.

- 5.—Larger; first two tergites vibrissate *monochroa* Cockerell.
 Smaller; tergites not vibrissate..... *angolensis*, new species.

The common Chilean *A. chloris* has spined posterior spurs, and is very distinct from the insect here described. *A. porteri* Bréthes is evidently *A. chloris*, as Herbst (1922) stated. Several years ago Herbst, in a letter, proposed the following synonymy:

Agapostemon (*Pseudagapostemon*) *xanthorhinus* Cockerell, 1918 = *citricornis* Vachal.

Rhopalictus callicladurus Cockerell, 1918. Color variety of *R. corynogaster* Spinola.

R. melanocladus Cockerell, 1918, male = *apicatus* Sichel, described from female.

His knowledge of the Chilean bee-fauna made it probable that these determinations should be accepted.

AMERICAN MUSEUM NOVITATES

Number 911

Published by
THE AMERICAN MUSEUM OF NATURAL HISTORY
New York City

February 25, 1937

AFRICAN BEES OF THE GENUS *HERIADES*

BY T. D. A. COCKERELL

The bees recorded below were obtained by the Cockerell-Mackie-Ogilvie Expedition of 1931-1932. The holotypes of the new species will all be found in The American Museum of Natural History. The genus *Heriades*, as commonly understood by European authors, includes some very diverse elements. The typical *Heriades* has spined axillae, after the manner of *Coelioxys*, and is widespread in both hemispheres. All those recorded in this paper have unarmed axillae, a series which in 1931 (Rev. Zool. Bot. Afr., XX, p. 336) I provisionally referred to a subgenus *Neotrypetes* Robertson, excluding however the new subgenus *Noteriades*, which perhaps deserves generic rank. Africa is extremely rich in species of *Heriades*, but in North America they are comparatively few. My friend Charles Michener, who is now revising the North American species, writes that they are all widespread, except *H. crawfordi* Graenicher, from Florida. Here the "age and area" principle may be said to operate, the genus on this continent, in the modern period, being very little prone to produce segregates. It was not always so, for in the Miocene shales of Florissant the species are numerous, as in Africa. *H. crawfordi* is quite closely allied to some of the African species.

The females of *Heriades* are usually to be distinguished by the characters of the mandibles, clypeus and basal band of metathorax. In *H. (Noteriades) bicornutus* Friese the mandibles are quadridentate, the innermost tooth (or dentiform angle) widely separated from the other three. The commonest type of mandible, shown by many species, is bidentate at the apex, with the inner angle obsolete or nearly so. But sometimes the inner angle is prominent though not dentiform (*H. livingstonei* Cockerell), or the mandible may be distinctly tridentate (*H. angustulus* Cockerell). In other species (as *H. pachygnathus* Cockerell) the broad mandible is edentate. The clypeal margin usually shows a series of nodules, which may number three or five, and may or may not be all alike. In *H. lobatus* Cockerell these structures are absent, but the species is by no means a typical *Heriades*. The basal band of metathorax has little cross-plicae, which may be dense and close, so that the surface is striate, or may be widely spaced, leaving

a series of shining pits. The ventral scopa is usually white, but it may be brassy yellow (*H. capicola* Strand) or red (*H. calviniensis* Cockerell). In some species the mandibles are red (*H. capensis* Friese). Some of the species are very small (*H. diminutus* Cockerell, the smallest, has the male about 3.2 mm. long), others quite large, up to *H. mamilliferus* Brauns (female 11–12 mm.). It is uncertain how much variation in size occurs within specific limits. In the present paper *H. civicus* is described, apparently different from the much larger *H. wellmani*, yet perhaps no more than a small variation. It is possible that large and small forms exist in the same regions, separated by different nesting habits, but it is also possible that the small individuals are the direct result of unfavorable conditions.

Heriades wellmani Cockerell, 1908 (*ciliatus* Friese, 1922)

Transvaal: Louis Trichardt, April 1932, 3 females (A. Mackie). A small species, with oblong head; clypeus and supraclypeal area very coarsely and densely punctured all over, the punctures running in lines; clypeal margin with three prominent tubercles, the middle one shorter and more obtuse; mandibles bidentate, the second tooth broad and obtuse; axillae not spined; scutellum highly polished, with a fringe of long hairs behind. It is a much stouter species than *H. campanularum* Kirby. This was compared with the type of *H. wellmani* from Angola, and I could not separate it. Friese's *H. ciliatus*, from Zululand and Bulawayo, S. Rhodesia, appears to be identical. In fresh specimens the white abdominal hair-bands are very distinct, though slender. The original description of *H. wellmani* failed to mention several important characters, so that Friese had reason for supposing *H. ciliatus* to be distinct. The type of *H. wellmani* is about 5.5 mm. long. I have a female of this size from Kloof Nek, Cape Town, Jan. 9, 1932 (A. Mackie), and can only refer it to *H. wellmani*. The type of the much smaller *H. civicus* was taken at the same time and place, and as the structural characters are about the same, it may be that *H. civicus* is really a variety of *H. wellmani*.

Heriades angustulus, new species

FEMALE.—Length about 4 mm., anterior wing 3 mm.; slender, black, with grayish wings and black stigma; tegulae very dark brown; axillae without spines, but a minute spine at each side of metathorax (compare *H. crawfordi* Graenicher). Head broad-oblong, with nearly parallel orbits; clypeus extremely densely and coarsely punctured all over, the punctures running in rows; clypeal margin trituberculate, the outer tubercles prominent, the middle one low and broad; supraclypeal

area and front very densely punctured, but upper margin of supraclypeal area shining; mandibles with apical half red, tridentate, the inner tooth sharp and prominent; no conspicuous hair on face; mesothorax and scutellum conspicuously shining, the mesothorax coarsely punctured in the same manner as the head, punctures of disc of scutellum well separated; postscutellum and base of metathorax finely wrinkled; second cubital cell long, receiving first recurrent nervure some distance from base; abdomen with narrow inconspicuous hair-bands on margins of tergites, most noticeable on third and fourth, lacking on fifth; ventral scopa white.

Cape Province: Oudtshoorn, Oct. 1931 (T. D. A. Cockerell). Differs from several small species (such as *H. larvatus* Friese and *H. matopensis* Cockerell) by the strongly tuberculate margin of clypeus. It is related to *H. wellmani* Cockerell, but the mandibles are quite different, more like those of *H. chariensis* Benoist, which has curved axillary spines.

Heriades angusticeps, new species

FEMALE.—Length about 4.5 mm., anterior wing 3 mm.; slender, black, the wings strongly dusky, but not reddish; mandibles, antennae and tegulae black; no axillary spines. Head very long, parallel-sided, in side view appearing almost as large as thorax, vertex strongly produced above eyes; clypeus densely and coarsely punctured all over, its lower margin arched, not tuberculate; front and upper part of sides of face with sparse hairs; mandibles bidentate at end, without salient inner angle (style of *H. truncorum* Linnaeus); head, thorax and abdomen closely and coarsely punctured, but shining between the punctures; scutellum large, polished, with well-separated punctures; stigma rather small; second cubital cell long, receiving first recurrent nervure far from base; tergites with slender inconspicuous hair-bands, lacking on fifth; ventral scopa pale yellowish.

Cape Province: Oudtshoorn, Oct. 1931 (J. Ogilvie). On first sorting out the specimens, this was confused with *H. angustulus*, but it is very different by the structure of mandibles and clypeus. The shape of the head at once separates it from *H. matopensis* Cockerell. The size agrees with *H. larvatus* Friese, which has the abdomen differently marked. The peculiar head is distinctive.

Heriades civicus, new species

FEMALE.—Length about 4.5 mm., anterior wing 3 mm.; black, with a broad-oblong head and rather short, robust, abdomen; mandibles and antennae black; tegulae dark brown; wings strongly dusky, stigma well developed, nervures pale brown, second cubital cell receiving the recurrent nervures about equally distant from (and close to) base and apex; no axillary spines; basal band of metathorax with coarse widely spaced plicae, the limiting margin with a double curve; basin of first tergite sharply defined. Head, thorax and abdomen coarsely punctured, but the punctures well separated on the shining discs of mesothorax and scutellum; no dense patches of white hair on face; clypeal margin with three very prominent tubercles, the middle one, though large, broadest and shortest; mandibles bidentate

at the faintly rufescent end, with no trace of an inner angle; tergites with a row of minute punctures along apical margin, but no hair-bands; ventral scopa white. There is a fringe of long hairs behind scutellum, as in *H. ciliatus* Friese.

Cape Province: Kloof Nek, Cape Town, Jan. 9, 1932 (Alice Mackie). Very similar to the two species described above; easily distinguished from *H. angusticeps* by the much shorter head and the tuberculate clypeus; from *H. angustulus* by the mandibles. Two females from Mitchell's Pass, Ceres (A. Mackie, J. Ogilvie), are larger and more robust (length 5 mm., anterior wing 3.6 mm.), but they have all the characters of *H. civicus*. It appears possible that *H. civicus* is only a variety of *H. wellmani*.

The species described as *Osmia dolichocephala* Friese (about 8 mm. long) seems to be related to these insects.

Heriades lobatus, new species

MALE.—Length about 7 mm.; anterior wing 4.8; robust, shining black, face covered with white hair; axillae not spined; abdomen turned downward at end, showing seven tergites, the sixth with a median keel, and a broad straight margin at each side with an angular lobe, so that seen from behind the tergite appears laterally dentate; seventh tergite forming a broad projecting semicircular lobe; no sternal processes, but two long fringes of yellowish hair. Mandibles, antennae and tegulae black; head, thorax and abdomen strongly punctured, but the punctures not dense; head transverse, broader than long, with a broad face; clypeus and supra-clypeal area very coarsely punctured; clypeal margin straight and simple, except that at each extreme side there is a low shining lobe; mandibles with a stout apical tooth, grooved down the back, and a rudimentary inner one; antennae reaching base of scutellum; mesothorax and scutellum shining, with well-separated punctures on disc; base of metathorax fluted, with numerous short strong rugae; wings strongly reddened; stigma rather small; first recurrent nervure meeting first intercubitus; abdomen shining and strongly punctured, first three tergites with white hair-bands at sides; basin of first tergite well margined; fourth and fifth tergites very coarsely and closely punctured.

Cape Province: Calvinia, Nov. 11–16, 1931 (J. Ogilvie). A peculiar species, not a typical *Heriades*. I thought it might be the male of *H. laticeps* Cockerell, which was based on a female from Calvinia. Its general appearance is quite the same, but the quite different position of the first recurrent nervure, the much coarser punctures of abdomen, and other characters seem to preclude such a reference. In Friese's table of Palaearctic *Heriades* it falls nearest to *H. moricei* Friese, but on comparing specimens, there is little resemblance.

Heriades nodulosus, new species

FEMALE.—This is the species which I recorded (1932) from Calvinia as *H. chubbi* Cockerell, but on re-examination I find it distinct. The clypeal margin has

three large tubercles (style of *H. trigibbiferus* Brauns), whereas in *H. chubbi* (type examined) there are only extremely small tubercles, hardly noticeable under a high power. The mandibles are broad, strongly bidentate at end, but with no third tooth; axillae not spined; base of metathorax with coarse well-separated plicae, the plicate band with a strong rim behind; fifth tergite somewhat hoary with fine hair; abdominal hair-bands developed at sides of first two tergites, and entire on the next three; ventral scopa white, collecting lemon-yellow pollen. The wings are faintly grayish, a little darker at apex, but not reddened; stigma rather large; first recurrent nervure joining second cubital cell not very far from base. The mesothorax and scutellum are polished between the coarse punctures, which on mesothorax run largely in rows. Length, 7 mm.

Cape Province: Calvinia, Nov. 13, 1931 (Alice Mackie). It is distinctly more slender than *H. pachygnathus*, with quite different mandibles and clypeus. *H. trigibbiferus* is much larger, with red scopa. From Nieuwoudtville, Nov. 1931 (A. Mackie), come two males and two females of *H. nodulosus*. The males have a delicate sulcus down the front, and much pure white hair at sides of face; the first two tergites have white hair-bands at sides; there is a keel down the middle of the last tergite. The abdomen is obtuse at end as in related species.

Heriades multistriatus, new species

FEMALE.—Length about 7 mm., anterior wing 4.3 mm.; no axillary spines; basin of first tergite sharply bounded; ventral scopa pure white. Clypeal margin appearing straight and simple under a lens, but the microscope shows five little tubercles, all alike; mandibles with two apical teeth, and no inner angle; tegulae dark brown; wings strongly brownish, second cubital cell receiving first recurrent nervure far from base; basal band of metathorax densely striate, the area beyond the band showing a dull surface, without sculpture, under the microscope, but shining in certain lights under a lens; abdomen shining, the punctures smaller than on mesothorax; a cuneiform patch of dense white hair at each side of first tergite, and a little white hair at sides of margin of second. The clypeus and supraclypeal area are strongly punctured, but shining between the punctures. This is very like *H. chubbi* Cockerell from Natal (type compared), but *H. chubbi* has smaller tegulae, more closely and coarsely punctured mesothorax, shorter mandibles and apical tergite hoary with fine pale hair.

Cape Province: Calvinia, Nov. 11–16, 1931, seven females (J. Ogilvie, L. Ogilvie, A. Mackie, W. P. Cockerell).

Heriades pachygnathus, new species

FEMALE.—Aspect of *H. multistriatus*, and on superficial examination not separated from it, having the basal band of metathorax finely striate, and the ventral scopa shining white. The punctures of postscutellum are small and dense, smaller than those on scutellum. The differential characters are found in the mandibles and clypeus. The mandibles are broad like an axe-blade, except that the long entire margin is moderately oblique. The clypeus is very coarsely, densely, reticu-

lately punctured, and the lower margin is convex, with a broad but short rounded tubercle in middle, and a couple of little tubercles, very much smaller than the median one, on each side.

Cape Province: Calvinia, Nov. 11-16, 1931, two females (L. Ogilvie).

The following key will facilitate determination:

- 1.—Mandibles bidentate at end; last tergite hoary with fine pale hair.
chubbi Cockerell.
- Last tergite not hoary.....2.
- 2.—Mandibles long, bidentate at end.....*multistriatus*, new species.
- Mandibles broad, edentate.....*pachygnathus*, new species.

Heriades chubbi Cockerell

Natal: National Park, three females (A. Mackie, J. Ogilvie). A male from the same locality (L. Ogilvie, March 1932) is referred here. In my key to Natal species (Ann. Durban Mus., 1920, p. 309) it runs out, having dark brown eyes and long flagellum. It is about 6.5 mm. long, anterior wing 4.6; wings dusky; pubescence white, forming a long beard over clypeus. The legs are ordinary. Abdomen obtuse and curved downward at end, as in related species; first tergite with a conspicuous white hair-band, the middle third of which is lacking; second tergite with an entire narrow band; third without a band; fourth with a fine band at sides; apical part of fifth with white hair. These abdominal characters distinguish it from *H. mandibularis* Fries, described from Natal (1922).

From the same locality (National Park), collected at the same time (March 1932) by the Ogilvies and Miss Mackie, come two females and four males which are appreciably larger and more robust than typical *H. chubbi*. I had set them aside as another species, but can only regard them as a larger variety. All the males show the entire hair-band on second tergite, and none at all on third. The base of the venter, in lateral view, shows a rounded prominence followed by a spine. Mixed with the females, but readily distinguished by the spined axillae, was a specimen of *H. marleyi* Cockerell. A male which I can only refer to *H. chubbi* is from Gum Tree, Orange Free State, Feb. 29 (A. Mackie).

Heriades speculiferus, new species

FEMALE.—Length about 8 mm.; black, including mandibles and antennae; tegulae very dark brown; wings strongly suffused with reddish brown; ventral scopa white; axillae not spined. Head large, with broad face, quite without patches of white hair; mandibles broad, edentate, the oblique cutting edge with a double

curve, the concave part innermost, the inner angle obtuse but distinct; clypeus densely and coarsely punctured, glistening between the punctures, the lower margin straight, with five small equal nodules, the apical corners elevated, forming conspicuous shining plates; supraclypeal area and front very densely punctured, vertex more sparsely, no trace of a frontal sulcus; cheeks very broad, rounded, with white hair beneath; thorax with very little hair, except about tubercles, and tufts behind wings; mesothorax and scutellum very coarsely punctured, but shining between the punctures; postscutellum with a brilliantly shining space on each side of the middle; basal band of metathorax with very minute irregular plicae; stigma well formed, black; second cubital cell receiving first recurrent nervure far from base, the second not so far from apex; abdomen shining, the punctures on first tergite rather small and close; basin of first tergite sharply defined; first two tergites with well-developed hair-bands at sides only, the abdomen otherwise not banded; apical tergite not hoary, its margin prominent.

Cape Province: Van Rhyn's Pass, Nov. 1931 (L. Ogilvie). A distinct species, to be compared with *H. pachygnathus* on account of the broad edentate mandibles, but the clypeus is quite different. The wings are much redder and the cheeks are broader than in *H. pachygnathus*.

Heriades arcuatellus, new species

FEMALE.—Length 4.5 mm., anterior wing 3 mm.; black, including mandibles and antennae, tegulae very dark brown; ventral scopa white; no axillary spines. Head broad-oblong; a little white hair at sides of face; mandibles short and broad, very briefly and obtusely bidentate apically, with no salient inner angle; clypeus densely punctured, but shining between the punctures, the lower margin arched, appearing simple when seen from below, but from above it is seen that there is a small but quite distinct median tubercle, and on each side of it, instead of similar tubercles, a long ridge; supraclypeal area shining but coarsely punctured; cheeks shining, in lateral view hardly as broad as eyes; front coarsely punctured, with a faintly indicated median sulcus; mesothorax coarsely punctured but shining; scutellum polished and sparsely punctured in middle; postscutellum highly polished in middle; basal band of metathorax with strong cross-plicae, not far apart; wings hyaline, slightly grayish, stigma well developed; second cubital cell receives first recurrent nervure not far from base; five hooks on hind wing; abdomen shining, second tergite with a conspicuous transverse sulcus; second to fourth tergites with very slender marginal bands of white hair, and some at sides of first; apical tergite shining between punctures, not appreciably hoary.

Cape Province: Blaukrans, near Calvinia, Oct. 1931 (Alice Mackie).

This is superficially like several other small species, but may be separated as follows (females):

- 1.—Head long, greatly produced above eyes.....*angusticeps* Cockerell.
Head not thus produced above eyes.....2.
- 2.—Head larger; wings not brownish.....*arcuatellus*, new species.
Head smaller; wings brownish.....3.

- 3.—Mandibles narrow, dark, bidentate at end.....*civicus* Cockerell.
Mandibles broader, with a salient inner angle, apical part dusky reddish.
angustulus Cockerell.

Heriades (Noteriades) bicornutus Fries

Belgian Congo (Katanga): Kafubu Mission, Sept. 1931, one female (A. Mackie). Compared with a specimen from Bulawayo, S. Rhodesia, determined by Fries. It is about 6.6 mm. long, the anterior wing 4.8 mm.

AMERICAN MUSEUM NOVITATES

Number 912

Published by
THE AMERICAN MUSEUM OF NATURAL HISTORY
New York City

February 27, 1937

BIRDS COLLECTED DURING THE WHITNEY SOUTH SEA EXPEDITION. XXXII¹

ON A COLLECTION FROM TANNA, NEW HEBRIDES

BY ERNST MAYR

In 1926 and 1927 the Whitney South Sea Expedition collected extensively in the New Hebrides. All of the northern islands were visited, but in the southern New Hebrides only a few skins were secured on Aneiteum and none at all on Erromango or Tanna. Last year the opportunity arose to secure with the aid of the Whitney fund the services of Mr. L. Macmillan who made a thorough ornithological exploration of the island of Tanna. He succeeded not only in getting nearly every species known from the island, but also added the following species to the list: *Puffinus pacificus*, *Puffinus lherminieri*, *Fregetta albobularis*, *Fregata ariel*, *Anas superciliosus pelewensis*, *Circus approximans wolfei*, *Falco peregrinus ernesti*, *Rallus (Hypotaenidia) philippensis*, *Ptilinopus greyi*, *Columba vitiensis leopoldi*, *Chalcophaps indica sandvicensis*, *Trichoglossus ornatus massena*, *Cacomantis pyrrhophanus schistaceigularis*, *Collocalia esculenta uropygialis*, *Lalage leucopygia simillima*, *Hirundo tahitica subfusca*, *Acridotheres tristis* (introduced), *Zosterops lateralis*, and several seabirds and wandering shorebirds. In spite of intensive collecting and diligent searching, he did not obtain the following species: *Accipiter fasciatus vigilax*, *Ducula bakeri*, *Coracina caledonica*, *Gerygone flavolateralis*, *Neolalage banksiana*, *Rhipidura spilodera*, *Clytorhynchus pachycephaloides*, *Pachycephala pectoralis*, *Aplonis zelandica*, *Guadalcanaria nobilis*, *Lichmera incana*, and *Erythrura cyano-virens*. Although one or the other of these species may still be discovered on Tanna, there is good reason to believe that the majority of them is absent from the island. It will be interesting to analyze the zoogeographical significance of this, after the completion of the survey of Erromango and Aneiteum.

The particular value of this collection consists in the fact that it was made on Tanna, the island which was chosen as the type-locality of most of the birds which were described from the New Hebrides during

¹ Previous papers in this series comprise American Museum Novitates, Nos. 115, 124, 149, 322, 337, 350, 356, 364, 365, 370, 419, 469, 486, 488, 489, 502, 504, 516, 520, 522, 531, 590, 609, 628, 651, 665, 666, 709, 714, 820 and 828.

the 18th and 19th century. This permits a comparison with the rich material collected by the Whitney Expedition in the northern New Hebrides and has resulted in the recognition of several forms which will be described in the present paper. A more detailed report on this collection will be published at a later occasion; in the present paper only some new forms are described. Mr. Macmillan is to be congratulated on the persistence and zeal with which he has gathered this important collection under the most trying circumstances.

***Zosterops lateralis macmillani*, new subspecies**

TYPE.—No. 330518, Amer. Mus. Nat. Hist.; ♂ ad.; Tanna, New Hebrides; October 11, 1935; L. Macmillan.

Similar to *Z. l. vatensis* Tristram, but darker and much larger; the back is extensively dark gray, only the lower rump being olivaceous; the lores and an extended region on the cheeks and below the eye are black; crown, nape, and sides of face are dark citrine olive, with a pronounced fuscous-blackish wash; the throat is duller, more greenish yellow; the bill is paler, entirely yellowish, except for anterior part of the culmen.

Wing, 7 ♂ ad. 70–73 (71.7), 7 ♀ ad. 68–72 (70.3); tail, 7 ♂ ad. 54–58 (55.9), 7 ♀ ad. 52–55 (53.3); culmen (from feathering) 12–13; tarsus 20–21.

RANGE.—Tanna and Aniwa Islands, southern New Hebrides.

It is surprising and highly interesting to find this giant race, right between the ranges of the very similar small *vatensis* (northern New Hebrides) and *griseonota* (New Caledonia). To judge from the descriptions the new form *macmillani* seems to have a coloration of the head similar to that of *nigrescens* Sarasin (Maré and Uvea), although I have seen no specimens of this Loyalty Island form, which is, of course, very much smaller (wing 59, 60) than *macmillani*. The broad white eye-ring serves to distinguish *macmillani* from *inornata* (Lifu) which is equally large.

It gives me great pleasure to name this excellent form after its discoverer.

***Zosterops flavifrons efatensis*, new subspecies**

TYPE.—No. 212597, Amer. Mus. Nat. Hist.; ♂ ad.; Efate Island, New Hebrides; June 4, 1926; R. H. Beck and J. G. Correia.

Similar to *Z. fl. flavifrons*, but much smaller; under parts of a brighter and clearer yellow; upper parts more yellowish olive, less citrine; infraorbital black streak less conspicuous.

Wing, 5 ♂ 59–64 (61.3), 4 ♀ 59–63 (60.7); tail, 5 ♂ 41–45 (43.0), 4 ♀ 41–45 (42.5); culmen 11–12; tarsus 20.

RANGE.—Efate and Nguna Islands, northern New Hebrides.

This race has already been well characterized by Murphy and

Mathews under the name *flavifrons*, (1929, Amer. Mus. Novitates, No. 356, p. 2). The authors at that time did not have any typical specimens from Tanna, and were forced to rely on Sharpe's statement (Ibis, 1900, p. 346) that birds from Efate agreed with Tanna birds. Since there is no modern description of typical *flavifrons* available I shall give a short diagnosis of this race, based on the specimens collected by Mr. Macmillan.

Zosterops flavifrons flavifrons (Gmelin).—Large, with a long bill; upper parts bright citrine olive, but forehead and supraloral region yellow; lores and inconspicuous infraorbital streak blackish; under parts yellow, brighter, almost orange, on the throat, but more or less washed with greenish on sides of breast and flanks; bill blackish.

Wing, 6 ♂ 64–68 (65.5), 7 ♀ 60–65 (63.0); tail, 7 ♂ 47–50 (48.7), 7 ♀ 45–49 (46.3); culmen, ♂ 14, ♀ 13; tarsus, ♂ 21, ♀ 20.

RANGE.—Tanna and Aniwa Islands (Macmillan coll.)

The Aneiteum form, *majuscula*, although similar to *flavifrons* in size, differs by coloration to such a degree that a comparison is unnecessary (see 1929, Amer. Mus. Novitates, No. 356, p. 5).

Myzomela cardinalis tenuis, new subspecies

TYPE.—No. 212936, Amer. Mus. Nat. Hist.; ♂ ad.; Epi Island, New Hebrides; Aug. 4, 1926; Mrs. J. G. Correia.

Similar to *M. c. cardinalis*, but very much smaller, particularly in regard to the bill; immature males and females apparently brighter, more greenish, less brownish on back and wings.

A series of 12 adult males from Epi measures as follows: Wing, 66, 67, 67, 68, 68, 68.5, 69, 69, 69, 70, 71; av. 68.2. Tail, 44, 45, 45, 46, 46, 46.5, 47, 47, 48, 48; av. 46.2. Bill, 15.5, 16, 16, 16.5, 16.5, 17, 17, 17; av. 16.4.

A series of 14 adult males from Gaua, Banks Is., measures: Wing, 67.5–72 (69.7), tail, 45–48 (46.7). A series of 12 adult males from Efate averages a little larger, approaching true *cardinalis* from Tanna: Wing, 69–74 (71.0), tail, 47–50 (48.6), bill, 17–18.5 (17.9).

A series of typical *cardinalis* from Tanna measures much larger. 4 ♂ ad., wing, 74, 74, 75; tail, 50, 50, 52, 53; bill, 18, 19, 19, 19; 1 ♂ imm., wing 71.5; tail, 50; bill, 16; 3 ♀, wing, 67, 67, 67; tail, 44, 46, 46.5; bill, 16, 16.5, 17. This compares well with the measurements of two Aneiteum males: Wing 72, 75; tail, 50, 51; bill, broken.

For further measurements, see Mayr, 1932, Amer. Mus. Novitates, No. 516, p. 22.

RANGE.—Northern New Hebrides from Efate Island northward and Banks Islands.

I suspected already in 1932 (*loc. cit.*) that there was a size difference between typical *cardinalis* from the southern New Hebrides and the birds of the northern islands. I had at that time, unfortunately, only

two specimens from Aneiteum, both with damaged bills. The topotypical material from Tanna has now enabled me to review the species once more and to name the small northern form.

***Myzomela cardinalis tucopiae*, new subspecies**

TYPE.—No. 216265, Amer. Mus. Nat. Hist.; ♂ ad.; Tucopia Island; February 11, 1927; R. H. Beck.

Similar to *Myzomela cardinalis tenuis*, but with a shorter bill; the scarlet of the under parts is restricted to the throat and does not extend to the upper breast.

♂ ad., wing 68, tail 48, bill 15.5, tarsus 19.5 mm.

RANGE.—Tucopia Island (168° 48' east, 12° 18' south), east of Vanikoro.

I have already in 1932 (Amer. Mus. Novitates, No. 516, p. 22) called attention to the characters of the single specimen collected by the Whitney South Sea Expedition on Tucopia Island. During the new revision of this species, undertaken after the receipt of Mr. Macmillan's material, the naming of the very distinct Tucopia bird has become a necessity.

AMERICAN MUSEUM NOVITATES

Number 913

Published by
THE AMERICAN MUSEUM OF NATURAL HISTORY
New York City

March 8, 1937

TEN NEW RODENTS FROM ANGOLA, AFRICA

BY JOHN ERIC HILL AND T. DONALD CARTER

Collections made in Angola by two expeditions from the American Museum, the Vernay Angola Expedition, 1925, and the Phipps, Bradley Expedition, 1932 and 1933, contain several apparently new forms of rodents. An account of the mammals of Angola is in progress, based largely on these collections, and more complete discussions of these forms and their relationships are included in it.

We wish to acknowledge our indebtedness to Dr. H. E. Anthony, Curator of Mammals, The American Museum of Natural History, for helpful advice and criticism in the preparation of this report.

Measurements are stated in millimeters and color terms are those of Ridgway, 1912, 'Color standards and nomenclature.'

Aethomys vernayi, new species

Figure 1

TYPE.—No. 85735, Amer. Mus. Nat. Hist., ♂ adult, skin and skull, from Chis-souque, 20 km. E. Dande, Angola. Collected by the Vernay Angola Expedition, August 4, 1925.

GENERAL CHARACTERS.—A short-tailed, big-eared rat with long, soft pelage; skull massive, with large tympanic bullae. Hind feet with 5th digit subequal to 1st.

COLORATION.—Upper parts variable, from near sayal brown to near olive-brown; sides much grayer, passing gradually to grayish-white under parts. Tail sparsely covered with bristle-like hairs; fuscous-black above.

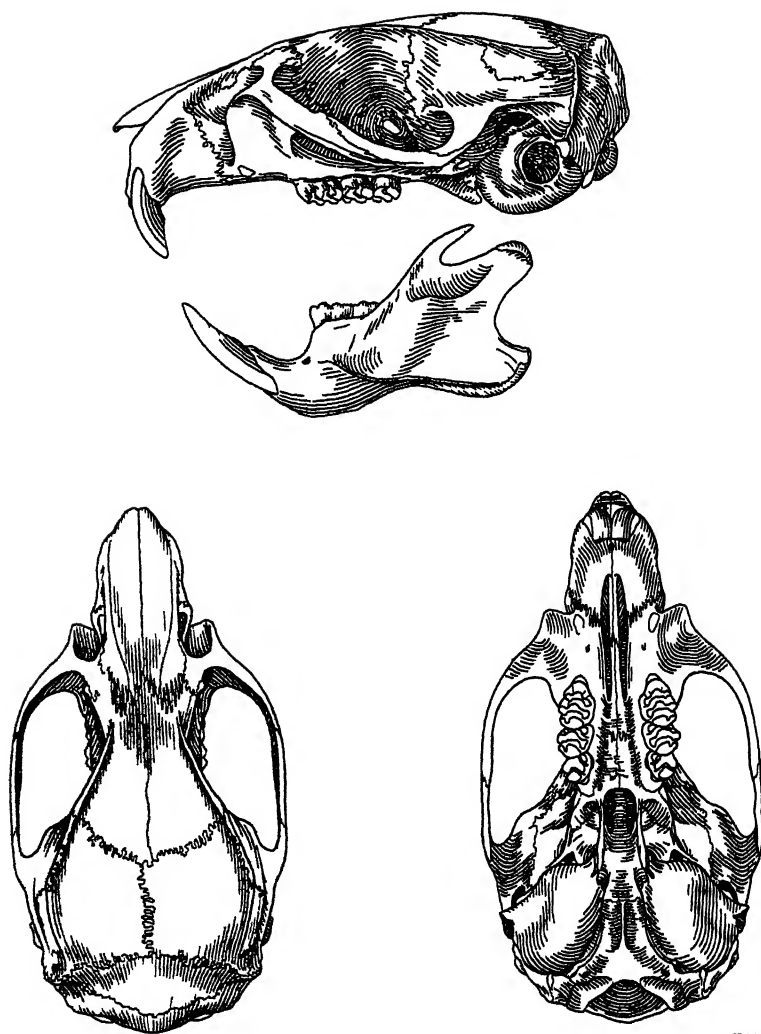
SKULL.—Broad and massive; rostrum and zygomata heavy; braincase short and broad. Tympanic bullae larger than in other Angolan species of *Aethomys*.

DENTITION.—Incisors heavy, moderately opisthodont. Molars very large.

MEASUREMENTS.—See table, p. 10.

Aethomys vernayi externally resembles *Thallomys*, but it may be distinguished from that genus by its much shorter fifth digit. Cranially they are quite distinct.

This form is based on the type and one specimen from the type locality. The species is named in honor of Mr. Arthur S. Vernay, the leader and organizer of the Vernay Angola Expedition.



H.Z. Hunt

A M 85735

Fig 1 Skull of *Aethomys vernay*, n sp $\times 2$

Aethomys avunculus phippsi, new subspecies

Figure 2

TYPE.—No. 87855, Amer. Mus. Nat. Hist., ♂ adult, skin and skull, from Humpata, alt. 6300 ft., Angola. Secured by the Phipps, Bradley Expedition (Mr. Lee S. Bradley, collector, orig. no. 645), December 7, 1932.

GENERAL CHARACTERS.—A dark race of *Aethomys avunculus* Thomas. Mammæ (in females) 0-2 = 4 or 1-2 = 6, usually the former.

COLORATION.—Upper parts near cinnamon with heavy black overlay; sides becoming near ochraceous-buff. Pure white midventrally, but rest of under parts with plumbeous bases. Tail above becomes near black at the tip.

SKULL.—Resembles that of *Mastomys*, elongate, slender. Zygomatic arches

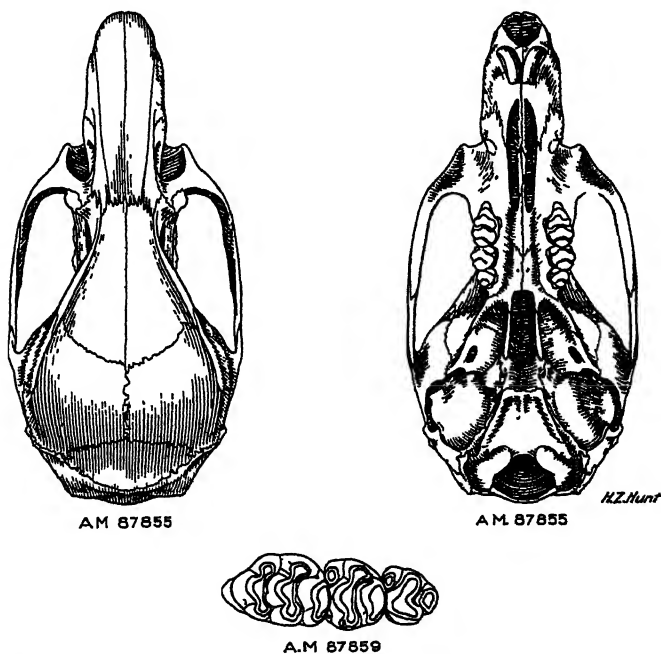


Fig. 2. Skull and dentition of *Aethomys a. phippsi*, n. subsp. $\times 2$.

more widely spreading than in the typical form, interorbital and mastoid regions broader, tympanic bullae and incisive foramina larger.

DENTITION.—Incisors orange, strongly opisthodont; M^1 with four roots, smaller than M^2 and M^3 combined.

MEASUREMENTS.—See table, p. 10.

The race is based on forty-seven specimens from the type locality. It is named in honor of Mr. John H. Phipps, who organized the Phipps, Bradley Expedition to Angola.

***Grammomys surdaster angolensis*, new subspecies**

TYPE.—No. 81947, Amer. Mus. Nat. Hist., ♂ adult, skin and skull, from Chitau, alt. 4930 ft., Angola. Secured by the Phipps, Bradley Expedition (Mr. Lee S. Bradley, collector, orig. no. 47), August 19, 1932.

GENERAL CHARACTERS.—A paler relative of *G. s. callithrix*.

COLORATION.—Back less reddish than in *callithrix*, near cinnamon, lined with black; sides becoming light ochraceous-buff at lower border. Under parts more nearly white, only faintly tinged with ivory-yellow. Feet faintly washed with cinnamon above, rather than cinnamon-buff. Tail darker. A well-marked blackish spot in front of the eye.

SKULL AND DENTITION.—Tympanic bullae larger than in *callithrix*; zygomatic arches and rostrum slightly wider. Molars larger, especially M^3 .

MEASUREMENTS.—See table, p. 10.

This genus was not previously known to occur in Angola, and only one specimen, in addition to the type, was secured.

***Dendromus mesomelas vernayi*, new subspecies**

TYPE.—No. 85909, Amer. Mus. Nat. Hist., ♀ adult, skin and skull, from Chitau, alt. 4930 ft., Angola. Secured by the Vernay Angola Expedition (Mr. Herbert Lang, collector, orig. no. 449), August 4, 1925.

GENERAL CHARACTERS.—A silky-haired *Dendromus* with broad dorsal stripe and buffy under parts; size smaller than *D. m. major* St. Leger.

COLORATION.—Upper parts between ochraceous-tawny and cinnamon-brown (about 14' j); mid-dorsal stripe wide. Under parts not set off from upper parts but paler, near pinkish buff (about 17' 'e); throat usually with area of pure white. Tail bicolored, drab above, whitish below, finely haired. Feet near pinkish buff above. Hair of cheek, shoulder, and inside of ear near orange-cinnamon, outside of ear near bister.

SKULL AND DENTITION.—Rostrum short and heavy. Incisors orange, deeply grooved, fairly heavy; M^1 larger than in *D. m. nyasae*.

MEASUREMENTS.—See table, p. 10.

This race is based on the type and twelve specimens from the type locality.

***Steatomys minutus leucorhynchus*, new subspecies**

TYPE.—No. 85846, Amer. Mus. Nat. Hist., ♂ adult, skin and skull, from Capelongo, Huilla district, Angola. Secured by the Vernay Angola Expedition (Mr. Herbert Lang, collector, orig. no. 304), July 21, 1925.

GENERAL CHARACTERS.—A pale race of *S. minutus* Thomas and Wroughton.

COLORATION.—Upper parts between wood brown and fawn color (about 15' 'a); sides and cheeks slightly paler. Under parts pure white, this including lower face, medial sides of legs, feet, and under side of tail; rhinarium and most of mystacial pad also white. Dorsal tail stripe near army brown; hairs of outer side of ear from natal brown to nearly fuscous.

SKULL AND DENTITION.—Agree closely with *S. minutus*.

MEASUREMENTS.—See table, p. 10.

This race is based on the type and three specimens from Capelongo.

Steatomys angolensis, new species

TYPE.—No. 88367, Amer. Mus. Nat. Hist., ♀ adult, skin and skull, from Chitau, alt. 4930 ft., Angola. Secured by the Phipps, Bradley Expedition (Mr. Lee S. Bradley, collector, orig. no. 964), March 6, 1933.

GENERAL CHARACTERS.—A small, dark gray *Steatomys*, with large ears; externally resembling *Malacothrix*, but hind feet 5-toed, with naked soles.

COLORATION.—Upper parts between hair brown and fuscous (about 15''''j); somewhat paler on sides of body and head. Under parts pure white, this including fore legs, medial sides of hind legs, feet, lower face and tip of muzzle. Tail drab above, whitish below. Ears colored like back, with narrow whitish margins, a conspicuous white spot at posterior base of each.

SKULL.—Smaller than in *S. bocagei* Thomas, but elongate; rostrum weaker, nasals appreciably narrower, tympanic bullae more inflated.

DENTITION.—Incisors opisthodont; molars smaller than in *S. bocagei*.

MEASUREMENTS.—See table, p.10.

Only a single specimen of this small mouse was secured.

Steatomys angolensis bradleyi, new subspecies

TYPE.—No. 87873, Amer. Mus. Nat. Hist., ♂ adult, skin and skull (latter injured), from Humpata, alt. 6300 ft., Angola. Secured by the Phipps, Bradley Expedition (Mr. Lee S. Bradley, collector, orig. no. 580), November 29, 1932.

GENERAL CHARACTERS.—A pale race of *S. angolensis* (see above).

COLORATION.—Upper parts between hair brown and cinnamon-drab (about 15''''h); rump brighter and sides paler, with an overlay of pinkish cinnamon. Under parts pure white as in typical race. Ears, color of back; tail whitish with dorsal stripe of drab.

SKULL AND DENTITION.—Skull and teeth agree closely with those of *S. a.*

MEASUREMENTS.—See table, p. 10.

This race, named in honor of Mr. Lee S. Bradley who collected the types of this and several other forms of rodents, is known only from the type specimen.

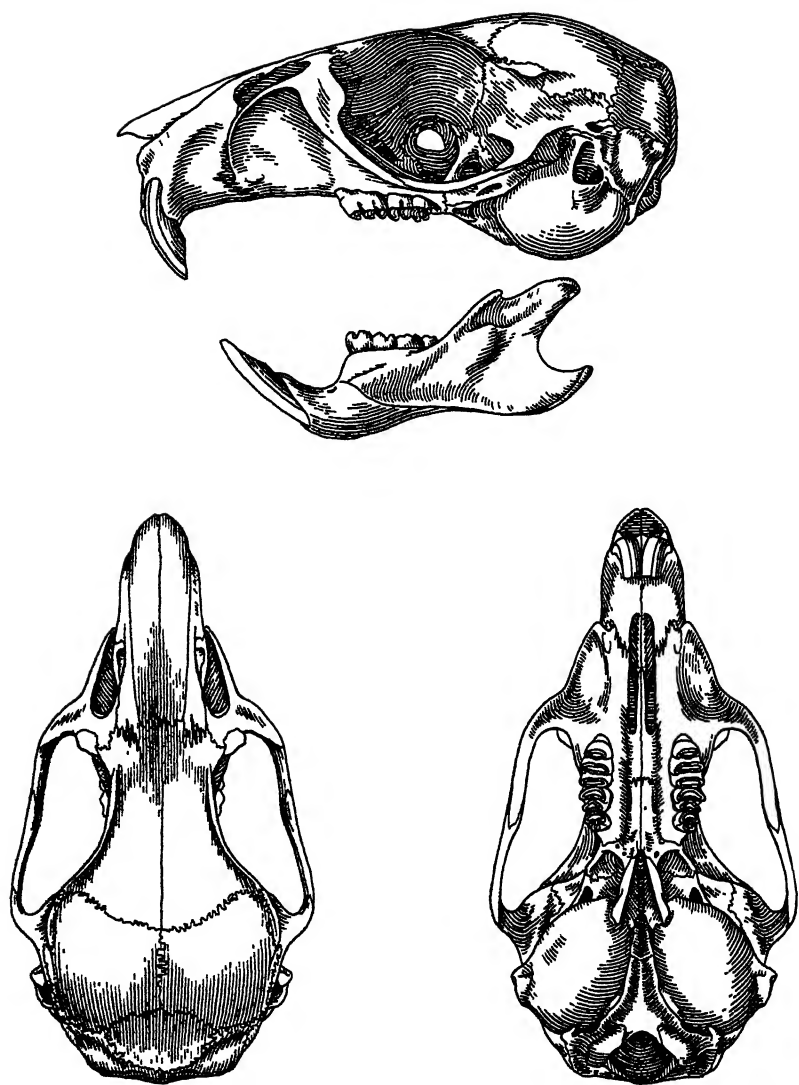
Taterona humpatensis, new species

Figure 3

TYPE.—No. 87952, Amer. Mus. Nat. Hist., ♀ adult, skin and skull, from Humpata, alt. 6300 ft., Angola. Secured by the Phipps, Bradley Expedition (Mr. Lee S. Bradley, collector, orig. no. 610), December 2, 1932.

GENERAL CHARACTERS.—A large species like *T. valida* but paler, with shorter skull and buffy under parts. Hind feet longer and more slender; pelage longer. Mammas 1-2 = 6, rather than 2-2 = 8 as in *T. valida*.

COLORATION.—Upper parts between natal brown and buffy brown, the sides with numerous white hairs intermixed. A whitish region between eye and ear; end of muzzle blackish brown and a black area below the eye. Under parts not set off sharply from upper parts; paler than tilleul-buff, the basal plumbeous showing through. Fore feet pinkish buff above, as are hind feet except toes.



H. Z. Hunt

AM. 87952

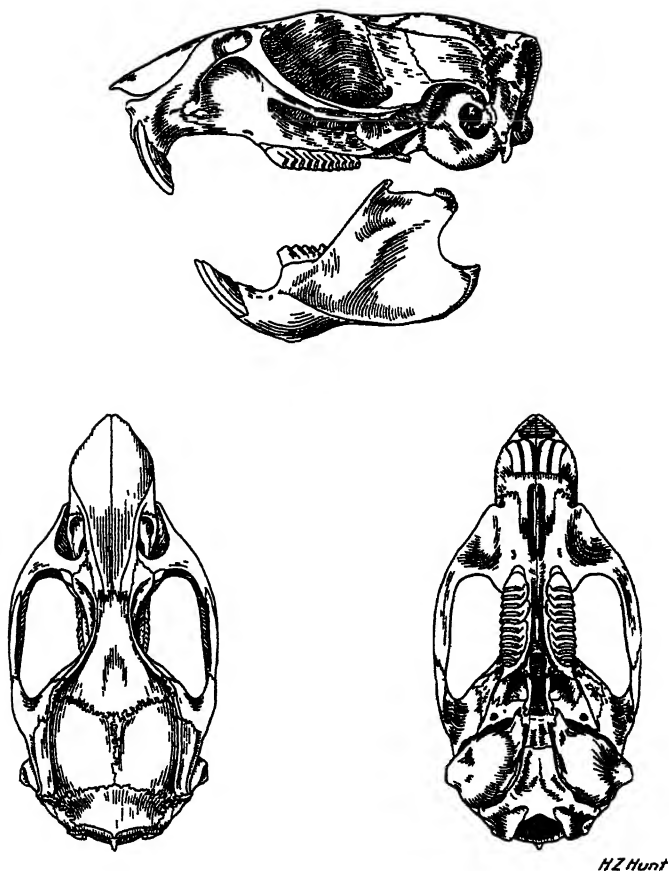
Fig. 3. Skull of *Taterona humpatensis*, n. sp. $\times 2$.

SKULL.—Shorter, lower and more convex dorsally than in *T. valida*, with less tapering nasals.

DENTITION.—Incisors more deeply grooved and molars decidedly smaller than in *T. valida*.

MEASUREMENTS.—See table, p. 10.

This species is based on the type and six specimens from the type locality.



AM 85841

Fig. 4. Skull of *Otomys cuanzensis*, n. sp. $\times 1\frac{1}{2}$.

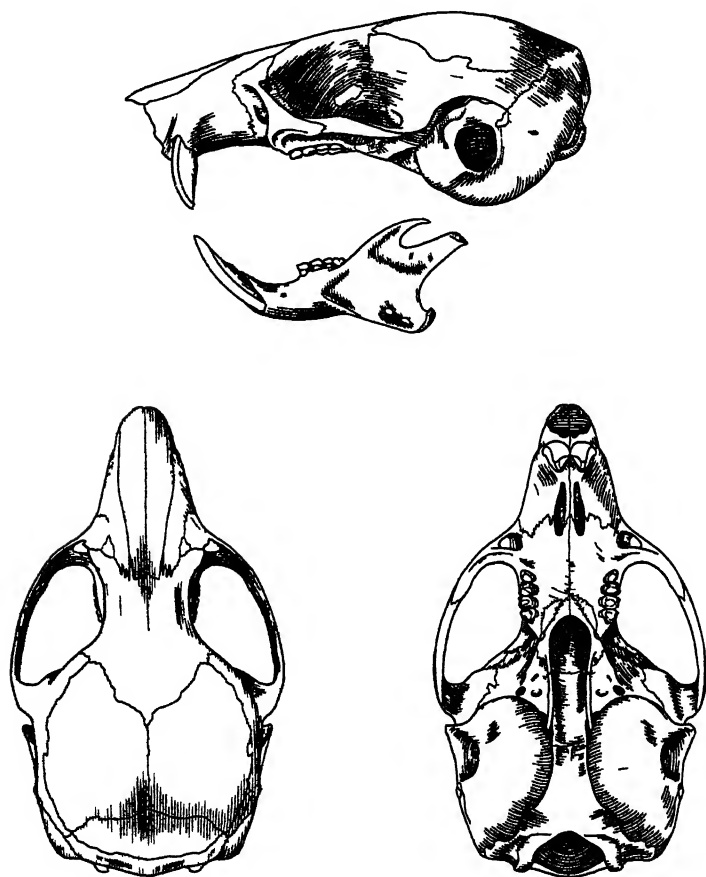
Otomys cuanzensis, new species

Figure 4

TYPE.—No. 85841, Amer. Mus. Nat. Hist., ♂ adult, skin and skull, from Chitau, alt. 4930 ft., Angola. Secured by the Vernay Angola Expedition (Mr. Her-

bert Lang collector, orig no 410), August 4 1925

GENERAL CHARACTERS—A brownish colored *Otomys* skull with interparietal and braincase wider than in *O. maximus* Roberts



AM 88191

HZ Hunt

Fig 5 Skull of *Clavigula a. cuanzensis*, n subsp $\times 2\frac{2}{3}$

COLORATION—Upper parts near sayal brown, heavily mixed with iridescent black, general color near bistre. Under parts paler, deep neutral gray overlaid with cinnamon-buff or paler. Tail with black dorsal stripe, clothed with cinnamon hairs below and on sides.

SKULL AND DENTITION—Like that of *O. maximus* but braincase and interparietal considerably wider, 61×110 (62×75 in *maximus*), temporal ridges

farther apart. Auditory meatus thickened anterodorsally. Molars weaker than in *marimus*.

MEASUREMENTS.—See table, p. 10.

This species is based on eight specimens from the type locality and one from Nambe, Cassonque. Its range probably includes the drainage of the Cuanza River, northern Angola. The differences between *cuanzensis* and *marimus* are definite although small, so it seems best at present to regard the new form as a separate species.

***Claviglis ansorgei cuanzensis*, new subspecies**

Figure 5

TYPE.—No. 88191, Amer. Mus. Nat. Hist., ♀ adult, skin and skull, from Chitau, alt. 4930 ft., Angola. Secured by the Phipps, Bradley Expedition (Mr. Lee S. Bradley, collector, orig. no. 713), February 12, 1933.

GENERAL CHARACTERS.—A small, drab-colored dormouse, with convex skull and small bullae.

COLORATION.—Richer than in *C. a. ansorgei*; upper parts between hair brown and cinnamon-drab, paler on shoulders and sides, near light drab on forehead. Under parts whitish, overlying dark plumbeous. Prominent black mask-like marking on face. Tail above between benzo brown and fuscous, mixed with whitish. Feet white, occasionally with gray markings dorsally.

SKULL.—Agrees closely with that of *C. a. ansorgei*.

MEASUREMENTS.—See table, p. 10.

This race is based on thirty-three specimens from the type locality. One specimen from 20 km. and one from 35 km. east of Dande are also referred to it.

Sex	Head and body	Tail	Hind foot (c.u.)	Ear (from notch)	Occipitonasal length	Basilar length	Nasal length	Diastema	Zygomatic breadth	Interorbital breadth	Mastoid breadth	Length incisive foramina	Length bullae	Length maxillary alveoli	Width M ¹
<i>Aethiops vernayi</i> Type: A.M.N.H. No. 85735 Chissonque, Angola	♂ 169	117	27 ¹	21	35.4	20.5	13.6	9.7	18.8	5.4	15.3	8.3	7.7	6.8	2.4
<i>Aethiops a. phillipsi</i> Type: A.M.N.H. No. 87855 Humpata, Angola	♂ 131	156	28		32.6	24.9	13.6	8.0	15.8	4.4	13.5	7.6	5.1	5.8	1.9
<i>Grammomys s. angolensis</i> Type: A.M.N.H. No. 81947 Chitau, Angola	♂ 109	166	23.5 ¹		29.0	21.6	10.6	7.0	14.6	4.5	11.6	6.2	5.0	4.7	1.5
<i>Dendromys m. vernayi</i> Type: A.M.N.H. No. 85909 Chitau, Angola	♀ 77	86	20	13	22.1	17.2	8.0	5.7	11.9	3.1	9.2	4.4	4.6	3.8	1.2
<i>Stenomys m. leucorhynchus</i> Type: A.M.N.H. No. 85846 Capelongo, Angola	♂ 85	45	17	14	23.5	20.5	9.3	6.4	12.1	3.9	11.1	4.5	5.9	4.1	1.4
<i>Stenomys angolensis</i> Type: A.M.N.H. No. 88367 Chitau, Angola	♀ 91	59	18	16 ¹	25.2	19.5	9.9	6.1	12.0	3.9	11.2	5.3	6.1	4.0	1.3
<i>Stenomys a. bradleyi</i> Type: A.M.N.H. No. 87873 Humpata, Angola	♂ 92	55	17	16	26.3	20.2	10.8	6.6			11.6	5.4	6.0	4.2	1.3
<i>Taterona humipatensis</i> Type: A.M.N.H. No. 87952 Humpata, Angola	♀ 147	170	38		38.4	30.2	15.5	10.7	20.7	6.8	14.9	7.3	10.0	6.5	2.4
<i>Otomys cuanensis</i> Type: A.M.N.H. No. 85841 Chitau, Angola	♂ 178	109	33	22	43.6	34.5	19.2	9.7	21.1	4.6	15.7	7.7	8.2	9.8	2.5
<i>Clavigilis a. cuanensis</i> Type: A.M.N.H. No. 88191 Chitau, Angola	♀ 87	62	16	12.7	23.8	18.5	9.0	5.1	13.7	3.8	11.8	2.9	7.5	2.8	

¹ Remeasured from dry skin.

AMERICAN MUSEUM NOVITATES

Number 914

Published by
THE AMERICAN MUSEUM OF NATURAL HISTORY
New York City

March 8, 1937

NEW GENERA AND SPECIES OF NEOTROPICAL HESPERIIDAE WITH NOTES ON SOME OTHERS

(LEPIDOPTERA; RHOPALOCERA)

By E. L. BELL

In arranging the HesperIIDae of The American Museum of Natural History collection a number of apparently undescribed species have been turned up and are here described. Two new genera are erected, one to include two of the newly described species which on their characters are not assignable to any genus now in use, and another to include a group of insects not congeneric with the type of the genus to which they have been previously assigned. The types and paratypes are in all cases in The American Museum of Natural History collection.

Oxynetra roscius Hopffer

Figure 1

Pyrrhopyge roscius HOPFFER, 1874, Stett. Ent. Zeit., XXXV, p. 370. Brasil.

Pyrrhopyge roscius DRAUDT, 1921, in Seitz, 'Macrolep. of the World,' V, p. 838.

This insect, which is rather rare in collections, is a member of the genus *Oxynetra* and not *Pyrrhopyge* where it has been usually placed by authors. The wing shape and form of the male genitalia is that of *Oxynetra*. It differs from the other members of the genus in lacking all hyaline spots of both wings, in the males.

A male and two females are in the collection of The American Museum of Natural History, from Massaranduba-Blumenau, Santa Catharina, Brasil. The male has the top of the head red except a black spot at the base of each antenna; palpi, collar, shoulder covers and a large spot at the base of the tegulae are the same color. Pectus is black. The anal two-thirds of the abdomen is red, ringed with black, the ring nearest the base is the broadest. The anal tuft is red. Ventral surface of the abdomen black with a central row of reddish spots. Fringes of primaries black with an occasional white scale in the lower half; those of the secondaries are white except at the inner angle of the wing where there are some black scales intermixed. The outer margin of the secondaries of the male is slightly excavate in the center. The female is

like the male except the wings are more rounded and without the excavation in the outer margin of the secondaries; top of the head black intermixed with red; the pectus with a few red hairs in the center. One female has white fringes on all four wings, except at apex of primaries and inner angle of secondaries; the other female has similar fringes of the secondaries but those of the primaries are intermixed with black.

Oxynetra flavomaculata, new species

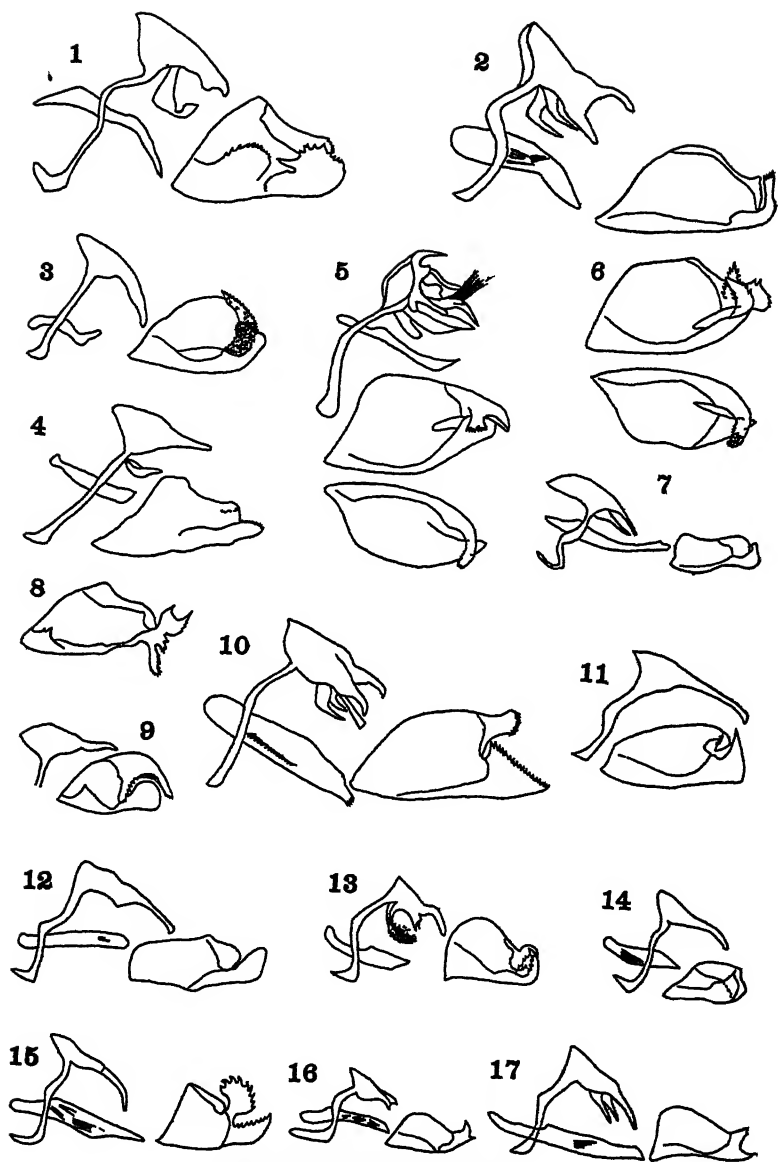
This species greatly resembles *roscius* in size, wing shape and characters of the red markings on the head and body but the primaries have a median band of five and a subapical band of five yellow hyaline spots. These two bands are placed similarly to those of *semihyalina* Felder but are narrower and yellow instead of white and there are no hyaline bands and spots on the secondaries.

Upper Side.—Male has a median band composed of a large, somewhat quadrate spot in the cell, extending completely across it; the next spot small and triangular in the base of interspace 3; the next directly beneath larger and elongate, tapered to a blunt point inwardly, in interspace 2 toward the base; the next two are in interspace 1 directly beneath the others, they are elongate but not as long as the spot above them, the inner tip of each is bent, that of the upper one downward and that of the lower one upward, and the two tips nearly touch in the middle of the interspace. The subapical series consists of a fine streak in interspace 8; a narrow, triangular streak in interspace 7; a shorter, triangular streak in interspace 6; a subquadrate spot in interspace 5; a narrow, elongate spot in interspace 4; the two last mentioned are just beyond the cell end and the whole band extends downward in a nearly straight

(Captions for figures)

Male genitalia of *Hesperiidae*. Where only one figure of the claspers is given, it is that of the left clasper.

- Fig. 1.—*Oxynetra roscius* Hopffer. New Bremen, Brasil.
- Fig. 2.—*Iliana romulus*, new species. Putumayo River, Peru. Type.
- Fig. 3.—*Pellicia nebula*, new species. New Bremen, Brasil. Type.
- Fig. 4.—*Pellicia* (?) *damon*, new species. Manicore, Brasil. Type.
- Fig. 5.—*Pellicia* (?) *phintias*, new species. Iquitos, Peru. Type.
- Fig. 6.—*Pellicia* (?) *achates*, new species. "Mapiri." Type.
- Fig. 7.—*Pholisora inornata*, new species. Ecuador. Type.
- Fig. 8.—*Ouleus gorgus*, new species. Punta Gorda, British Honduras. Type.
- Fig. 9.—*Pholisora putumayo*, new species. Putumayo River, Peru. Type.
- Fig. 10.—*Iliana remus*, new species. Putumayo River, Peru. Type.
- Fig. 11.—*Pholisora banosa*, new species. Banos. Ecuador. Type.
- Fig. 12.—*Pholisora catharina*, new species. New Bremen, Brasil. Paratype.
- Fig. 13.—*Pholisora balsa*, new species. Balsapuerto, Peru. Type.
- Fig. 14.—*Pholisora* (?) *angulata*, new species. Marumba, Brasil. Paratype.
- Fig. 15.—*Pholisora aplica*, new species. Chilpancingo, Mexico. Type.
- Fig. 16.—*Cogia evansi*, new species. Santa Cruz, Bolivia. Paratype.
- Fig. 17.—*Pholisora chilpancingo*, new species. Chilpancingo, Mexico. Type.



(See opposite page for captions)

line from the costa and would parallel the median band if continued. The wings are greenish black, duller beneath. Fringes of the primaries black; of the secondaries white except at the inner and anal angles where they are black.

Head red with a black spot at the base of each antenna. Collar red. Shoulder covers black at the extreme sides, the rest red. Tegulae black with a large red spot at the base. Pectus black. Thorax beneath and the legs blue-black. Abdomen above with the basal third blue-black, the rest red edged with black, the ring nearest the base the broadest; beneath blue-black with some reddish central spots. Anal tuft red. Antennae black.

The female is like the male, the wings more rounded; the spots of the median band of the primaries are larger, those in interspace 1 elongate and lying one close above the other; the upper one of the subapical spots is shorter than the one beneath it; the fringes of the primaries are white except at the extreme apex; some central red hairs in the pectus.

The male genitalia appear to be the same as that of *roscius*.

Expanse.—Male, 52 mm.; female, 54 mm. (twice the distance from center of thorax to apex of one primary).

Types.—Holotype male and allotype female, New Bremen, Santa Catharina, Brasil, March 27 and February 4.

Cogia evansi, new species

Figure 16

Closely allied to *hassan* Butler and *freudiae* Williams and Bell, but widely differing from both in the form and position of the whitish bands on the underside of the secondaries.

MALE.—Upper side of both wings varying in individuals from rather light brown to chestnut brown. Primaries with four minute whitish subapical spots in an oblique line in interspaces 6, 7, 8 and 9, sometimes very indistinct; a small whitish spot in the cell on the upper margin toward the end, occasionally absent; a pale outer marginal line, very narrow. Fringes paler brown, crossed by dark brown at the end of the veins, a narrow dark basal line, a small white spot at the apex of the wing. Secondaries unmarked except for a very narrow, pale outer marginal line; the hair tuft in the abdominal fold a little paler brown and inconspicuous. Fringes paler brown intermixed with darker and crossed by still darker brown at the end of the veins, except at vein 6 where they are whitish at the tips, these characters being somewhat variable in individuals.

Beneath.—Primaries dark brown along the costa, apical area and inner margin to vein 1, all the rest of the wing pale grayish brown; apical area heavily overscaled with whitish which is continued in a narrow submarginal line paralleling the outer margin to vein 2, except in one male having less heavy overscaling confined to the apical area. A narrow, white terminal line; the veins in the apical area and outer marginal quarter of the wing pale brownish to whitish. Subapical spots repeated and more distinct; the cellular spot repeated and in some individuals continued above the cell almost to the margin of the wing; in two specimens lacking the cell spot on the upper side it is present on the under side above the cell only. Fringes as above, a little paler, the white subapical spot repeated. Secondaries dark violet-brown, with the following continuous, very narrow, whitish bands: first, a bar across interspace 7 near the base, continued above vein 8 halfway to the margin of the

wing; second, a band across interspace 7 to the abdominal fold sharply bent inward at the upper margin of the cell, this band is also continued above vein 8 halfway to the margin where it is connected by a slightly convex bar with the top of the first band; third, from vein 8 to the abdominal fold, a little dislocated at the upper edge of the cell and slightly convex from there to the fold; fourth, from vein 8 to the abdominal fold, farther from the third band than that band is from the second; fifth, from vein 7 to the abdominal fold, approximately the same distance from the fourth band as the third band is from the second band; sixth, marginal, from vein 8 to the anal angle. The entire wing overscaled with whitish and pale brown, some times heavily so. Abdominal fold pale grayish brown with a thin white line along the inner margin. Veins white or very pale brownish. Fringes as above.

Head and body above brown. Palpi beneath white. Pectus and thorax grayish white. Abdomen beneath grayish white spotted with brown. Antennae above brown, beneath grayish brown, the apiculus reddish.

FEMALE.—Slightly larger and darker, the primaries beneath with only the inner margin pale brownish; otherwise similar to the male.

EXPANSE.—Male, 25–30 mm.; female, 30 mm.

TYPES.—Holotype male; allotype female; three male and one female paratypes, Santa Cruz, Bolivia.

Named for my friend Brigadier W. H. Evans of the British Museum.

Pellicia nebula, new species

Figure 3

Resembles the *macarius* Herrich-Schaffer, *bessus* Moschler, *ephora* Herrich-Schaffer group of these insects, the rather short hair tuft of the secondaries being nearer to that of *macarius*, from which *nebula* may be distinguished by the form of the male genitalia. *Nebula* is a little smaller than *bipuncta* Schaus, found in the same locality, and the lower subapical hyaline spot is smaller and more directly under the upper one, the black bands on the wings more indistinct, the marginal area of the primaries not as distinctly paler, and the hair tuft of the secondaries shorter than in that species.

Upper Side.—Blackish brown. Primaries with the following narrow, indistinct black bands: one near the base of the wing; a black spot in the cell extending across interspace 2; one from the costa around the end of the cell to vein 1; one submarginal. Two hyaline subapical spots, one in interspace 8, the larger; one in interspace 7 very minute, and almost directly beneath the upper one. Secondaries with a black basal spot; a discal band bifurcated near the end of the cell and both sections extending to the abdominal fold; a submarginal band, all blackish and indistinct.

Under Side.—Primaries a little paler than above; subapical spots repeated; bands of the upper side repeated except the basal one; inner margin below vein 1 and in the basal three-quarters of interspace 1 pale brownish; a pale brownish spot at the apex. Secondaries, anal half paler than the rest; bands of the upper side repeated and more distinct in the paler anal area; a pale transverse bar in the cell.

Body above and beneath dark brown. Palpi beneath and pectus brown with some pale yellowish-brown hairs. Antennae blackish on both sides, club beneath reddish.

EXPANSE.—42 mm.

TYPE.—Holotype male, New Bremen, Santa Catharina, Brasil.

Pellicia (?) *damon*, new species

Figure 4

Upper side rufous brown. Primaries with four blackish bands, the first a short sub-basal band composed of two spots, one in the base of the cell and the other immediately below it in interspace 1; the second, a large, squarish black spot in the cell before the end and a smaller, oblong spot below it in interspace 2; the third, composed of elongate spots, from the costa around the end of the cell to vein 1, somewhat dislocated below the end of the cell; the fourth, submarginal. Fringes concolorous. Secondaries with a black spot in the base of the cell; another squarish spot in the middle of the cell with two minute streaks above it; a discal band of spots beginning on vein 7, bifurcated on vein 5, the two sections extending to near the abdominal fold; a submarginal band of spots. Fringes concolorous.

Beneath rufous brown, paler than above. Primaries with the outer three bands repeated but less distinct; inner margin and lower base paler grayish brown. Secondaries a little paler than primaries, bands and spots of upper side repeated; a large blackish brown spot at the anal angle; abdominal fold with bluish-gray hairs.

Head and body above dark brown; a few bluish-gray hairs on the front of the head just above the palpi. Pectus, palpi and thorax beneath—bluish gray. Abdomen beneath whitish with a dark brown central line. Antennae black on both sides, the apiculus somewhat reddish beneath.

EXPANSE.—42 mm.

TYPE.—Holotype male, Manicore, Brasil.

P. damon and the two following described insects are probably not strictly congeneric with *dimidiata* Herrich-Schaffer, the genotype of *Pellicia*, but they so closely agree with a number of species in the genus in coloration, wing shape and form of maculation that they will be readily recognized here. They differ from *Pellicia* in not having a hair tuft or swollen veins on the secondaries and the form of the male genitalia is different. Compared with other closely related genera, they differ from *Eracon* Godman and Salvin in the more pointed primaries and lack of hair tuft on the hind tibiae; from *Gorgopas* Godman and Salvin they differ in having no costal fold on the primaries and no metallic overscaling on the body or wings; from *Mycteris* Mabille they differ in having no hair tuft or swollen veins on the secondaries. Despite the lack of the secondary sexual characters of *Pellicia*, and the somewhat different form of the male genitalia, there may be some doubt as to the actual necessity of a new genus to contain these insects and the writer refrains from erecting one. The insect previously described by the writer as *Eracon* (?) *duidae* (1932, American Museum Novitates, No. 555, p. 12, Fig. 5) much resembles these three insects in superficial appearance and is most closely related to *damon* and it may eventually have to be placed with them.

Pellicia (?) *phintias*, new species

Figure 5

This insect so closely resembles *damon* that a detailed description of it would be for the most part a mere repetition of the description of that insect, therefore only the differences between the two seem necessary to be given here.

Upper side darker rufous brown. Primaries with the dark bands less distinct and a very minute, indistinct spot at the end of the cell; the third band less dislocated below the end of the cell. Secondaries with the bands very indistinct and an additional black spot of the submarginal band above vein 7.

Beneath darker than *damon* and with a purplish sheen. Primaries with inner margin and lower base paler but not as much so as in *damon*. Secondaries with the large blackish anal spot extended to vein 2 as part of the submarginal band; the bluish-gray hairs of the abdominal fold extend narrowly to vein 2 on either side of the black anal spot.

Body, palpi and antennae as in *damon*.

Expanse.—42 mm.

TYPE.—Holotype male, Iquitos, Peru.

Despite the very close superficial resemblance between *damon* and *phintias*, the details of the genitalia are very different as will be readily seen from the accompanying figures.

Pellicia (?) *achates*, new species

Figure 6

This insect also closely resembles *damon*, is a trifle smaller, the color a little paler rufous brown, with the same form of maculation on both wings. The two outer, blackish bands of the primaries are somewhat narrower. On the under side of the primaries the dark bands of the primaries are very indistinct. The outer half of the secondaries is paler than the basal half; the bluish-white overscaling in the abdominal fold is very scattered; and there is no dark spot at the anal angle. Head, body and palpi same as in *damon*. The club of the antennae pale brownish beneath.

The form of the genitalia of *achates* differs from that of *damon* in the uncus and both claspers and is nearest to that of *phintias* differing principally in the left clasper.

Expanse.—40 mm.

TYPE.—Holotype male, "Mapiri."

NOCTUANA, NEW GENUS

GENOTYPE.—*Helias noctua* Felder

This genus is erected for certain insects which Godman and Salvin included in the genus *Theagenes* and their South American allies.

These insects differ from *aegides* Herrich-Schaffer, the genotype of *Theagenes*, and its allies in having a distinctly swollen antennal club with a sharp pointed apiculus hooked beyond the middle; in *Theagenes* the club is gradually thickened, arcuate and tapers to a more or less blunt point. The third papal joint is shorter. The primaries are broader; the secondaries longer, more produced at the anal angle, the outer margin

dentate. A costal fold may be present or absent in the males. The hind tibiae of the males have a long fringe. In the male genitalia the uncus is long, tapering, with a slightly bulbous apex; the claspers are broad, blunt, divided at the apex, the lower left and both right divisions strongly toothed, and are not quite symmetrical.

The relationship of *Noctuana* is nearer to *Pellicia* than to *Anisochoria*, with which genus the writer believes *Theagenes* to be synonymous.

The species at present described and belonging in the genus *Noctuana* are: *noctua* Felder; *bipuncta* Plotz; *brunneofusca* Mabille and Boulet; *brunneofusca* form *uniformis* Mabille and Boulet; *diurna* Butler (*bellinita* Plotz); *haematospila* Felder; *lactifera* Butler and Druce; *stator* Godman and Salvin.

The name *Noctuana* for this genus was suggested by Brigadier W. H. Evans of the British Museum.

Noctuana lactifera Butler and Druce

Helias lactifera BUTLER AND DRUCE, 1872, Cistula Ent., I, p. 115. Costa Rica.

Theagenes lactifera GODMAN AND SALVIN, 1899, 'Biol. Centr.-Amer.,' Rhop., II, p. 459, Pl. xci, figs. 30, 31, 32.

Godman and Salvin state that the type of *lactifera*, in the British Museum, is a female. They associated with it, males of similar appearance having a costal fold on the primaries. I am informed by Brigadier W. H. Evans that the type of *lactifera* is a male and lacks the costal fold. The lack of the costal fold probably caused Godman and Salvin to believe it to be a female. The name *lactifera* must therefore be applied to the insect which has no costal fold in the male.

The other very similar insect having a costal fold in the male is *bipuncta* Plotz, heretofore considered to be a synonym of *lactifera*. Plotz described *bipuncta* in the genus *Antigonus*, giving as one of the characters, the costal fold, and stating the habitat to be Mexico. *Bipuncta* seems to be a slightly smaller insect than *lactifera* on the general average of size but is very similarly marked.

In The American Museum of Natural History collection there are two male specimens of *lactifera*, one from Costa Rica and one from Guatemala; and thirteen male specimens of *bipuncta* from Mexico and Guatemala.

ILLIANA, NEW GENUS

GENOTYPE.—*Illiana romulus*, new species.

Primaries rather short and broad, apex pointed, costal margin slightly curved, outer margin a little rounded, inner margin slightly longer than the outer margin, cell about two-thirds the length of the wing, a well-developed costal fold.

Secondaries somewhat triangular, longer than the abdomen, outer margin nearly straight, very little rounded.

Palpi long, roundish, the scales closely set, third joint moderate in length, conical, projecting straight forward from the second joint.

Antennae not reaching the end of the cell, the club very long, gradually thickened, tapering to a long, sharp pointed, hooked apiculus which is not as long as the club.

Hind tibiae with a dorsal fringe and two pairs of spurs.

The uncus of the male genitalia is broad at the base, from both sides of which project forward a down curved, apically pointed arm. The saccus is very short. The aedoeagus is stout and carries internal spines. The claspers are approximately symmetrical, apically divided, one or both divisions carrying short but well-developed apical serrations.

The superficial appearance of the two species here described in this genus somewhat resembles that in the genus *Aethilla* Hewitson, from which they principally differ in the form of the palpi, the presence of a costal fold on the primaries of the male, the lack of a tibial tuft. the very different form of the male genitalia.

Ilia romulus, new species

Figure 2

Upper side dark brown. Primaries with two, narrow, very indistinct darker bands from the costa to vein 1, the first through the middle of the cell; the second around the end of the cell; a little paler from the second band to the outer margin and with a faint violet tinge. Secondaries with two very narrow dark bands from vein 8 to the abdominal fold, beginning close together on vein 8, the outer band diverging outwardly a little below the cell end and then curving inwardly; the area between the outer band and the margin of the wing is a little paler and with the violet tinge more pronounced than on the primaries. Fringes of both wings brown, the tips a little paler.

Beneath.—Primaries dark rufous brown, the dark bands of the upper side barely discernible; narrowly paler along inner margin; the dark fringes with a paler basal line. Secondaries, costal area above the cell dark rufous brown; rest of the wing paler brown, palest at abdominal fold and anal angle; the dark bands of the upper side are only visible as two indistinct spots in and above the end of the cell; a thin terminal line of bluish-white scales, which extend a little onto the base of the fringes, from the outer angle to the anal angle, heaviest just above the abdominal fold.

Head and body above, palpi, pectus and thorax beneath dark brown; abdomen beneath sordid whitish with a dark brown central line. Antennae on both sides blackish, the apiculus somewhat reddish beneath.

Expanse.—42 mm.

TYPE.—Holotype male, Putumayo River, Peru.

Ilia remus, new species

Figure 10

Upper side very dark brown, darker than in *romulus*, the bands of the primaries not visible; those of the secondaries but barely so and appear to be of the same form

as in *romulus* but a little wider apart where they begin on vein 8. There is no violet tinge on the outer area of either wing.

Beneath.—Primaries dark brown, a little paler along the inner margin; fringes with a narrow, paler basal line. Secondaries same color, the outer band barely visible; a thin terminal line of bluish-white scales which extend inwardly in a thin ray in the center of interspace 1; an indistinct darker spot at the anal angle; and a hazy indication of a submarginal row of darker spots.

Head and body above dark brown; palpi missing but indications are that they are dark brown; thorax beneath dark brown with some gray hairs; abdomen beneath whitish with a brown central line. Antennae blackish on both sides.

Expanse.—42 mm.

TYPE.—Holotype male, Putumayo River, Peru.

Ouleus gorgus, new species

Figure 8

Belongs in the group with *fridericus* Geyer, the primaries without hyaline subapical spots, the wings more uniformly brown and the maculation in the form of definite bands similar to those found in some of the species of *Pholisora*. The short, porrect terminal joint of the palpi and the rather long, gradually thickened club of the antennae, with a sharp pointed apiculus, ally this insect more closely with *Ouleus* than *Pholisora*.

Upper side brown. Primaries with three, narrow, darker bands, the first through the middle of the cell, from the costa to vein 1; the second, from the costa around the end of the cell to the inner margin; the third submarginal. Fringes brown. No costal fold. Secondaries with three dark spots at the base; a curved discal band from costal margin to abdominal fold, bifurcated below the end of the cell; a submarginal band. Fringes brown.

Beneath a little paler. Primaries narrowly paler along inner margin and at inner angle; a small pale spot at the apex; bands of the upper side repeated. Secondaries a little paler in the anal half; bands of the upper side repeated except the basal spots, that area being entirely brown.

Head and body above and beneath, including the palpi, brown. Antennae blackish above, beneath brownish, the club reddish in the apical half.

Expanse.—36 mm.

TYPE.—Holotype male, Punta Gorda, British Honduras.

The uncus was so badly broken in preparation that it could not be shown in the accompanying figure. The claspers are approximately symmetrical and are remarkable for the peculiar, heavily chitonized, projections from the ventral edge at the apex.

Pholisora giselus race *boliviensis*, new race

Differs from typical *giselus* Mabille principally in the much larger size, so much so that it might readily be taken for a distinct species. Two of the four males present lack all trace of the subapical spots of the primaries usually found in Central American specimens; one has a minute dot in interspace 8, showing on both sides of the wing; one has a mere trace of a dot in the same interspace showing only on the under side of the wing.

Expanse.—37 to 38 mm.

Types.—Holotype male and three paratype males labelled "Cochabamba, Bolivia."

The form of the male genitalia is identically the same as that of *giselus* Mabille.

Pholisora chilpancingo, new species

Figure 17

Superficially resembles *evippe* Godman and Salvin and *giselus* Mabille, from which it can hardly be accurately distinguished except by the form of the male genitalia which is very different from that of either of the two species mentioned.

On the upper side the wings are dark brownish with the usual indistinct, darker transverse bands and are variably overscaled with dark fulvous. One specimen, the type, has a minute, white subapical dot in interspace 8 of the primaries; another specimen has no trace of this spot on the upper side but it is barely indicated on the under side; the third specimen has no trace of the spot on either side. Costal fold of primaries is present.

Under side of wings dark brownish. Outer marginal quarter of primaries paler, with a row of paler spots extending from costa around the cell end to near the inner margin and some faint black dashes just beyond the end of the cell; inner margin grayish, especially at the base. Secondaries with a curved discal and outer row of pale spots, which are merely accumulations of yellowish scales and not well defined; a variable overscaling of fulvous, especially in and along the abdominal fold. Fringes dark brown, somewhat grayish at the tips.

Top of head and thorax dark brown and fulvous. Palpi beneath white with a few black hairs, the third joint black and fulvous. Pectus grayish or yellowish white. Abdomen above brown, beneath brown and fulvous. Thorax beneath grayish. Antennae above blackish brown, beneath spotted with fulvous, the club entirely fulvous.

Expanse.—33-40 mm.

Types.—Holotype male, Chilpancingo, Mexico, and two male paratypes, Balsas, Mexico and "Mexico."

Pholisora catharina, new species

Figure 12

This insect has considerable superficial resemblance to *giselus* race *boliviensis* but is still larger.

The upper side of the wings is dark brown. The primaries of the male have a darker spot in the cell near the end, which is narrowly and faintly continued to vein 1; a broad, dark band from the costa around the end of the cell to the inner margin; a broad dark, marginal band. A prominent costal fold is present on the primaries of the male. There are no subapical spots in either sex. The secondaries are crossed by three curved bands of irregular, ill-defined, paler spots. Both wings are variably overscaled with fulvous.

Beneath slightly paler than above. Primaries with outer marginal quarter paler than the rest; in some specimens there are a few dark dashes at the apex; bands of the upper side faintly visible; inner margin narrowly paler. Secondaries usually a

little paler in the lower half; the pale bands of the upper side variably present; a sparse overscaling of fulvous.

Head and thorax above brown with a little fulvous. Palpi beneath, the third joint black and a little fulvous, the rest, and the pectus, brown heavily intermixed with yellowish white to fulvous. Abdomen above and beneath brown with a little fulvous. Thorax beneath brown and sordid yellowish to fulvous. Antennae above blackish brown, beneath spotted with pale fulvous, the club yellowish.

Female similar to the male, a little paler, the bands of both wings above and beneath a little more distinct; the fulvous overscaling of the secondaries somewhat heavier and extending onto the primaries.

Expanse.—Male, 38–40 mm, one small specimen 35 mm., female, 40–42 mm.

Types.—Holotype male and allotype female, New Bremen, Sta. Catharina, Brasil. Paratypes: four males and five females, New Bremen; one male and one female, Massaranduba-Blumenau, Brasil.

Pholisora banosa, new species

Figure 11

This is another large species of *Pholisora*, approaching *catharina* in size but the color of the upper side of the wings has a more rufous tint and the dark bands of the primaries are lacking.

Upper side of the wings rufous brown. Primaries with a band of small, indistinct, pale spots extending from the costa around the cell end to vein 1, the two lower spots, in interspace 1, somewhat bent inwardly from the rest of the band; a few scattered fulvous scales; inner margin narrowly paler. There are no subapical spots and no costal fold. Fringes dark brown. Secondaries with a hazy indication of a discal curved band of paler spots and a narrow stripe in the cell; a sparse overscaling of fulvous.

Beneath a little paler than above. Primaries with outer marginal area paler than the rest; an overscaling of fulvous in the apical area. Secondaries paler in the anal half; pale band and cell stripe of upper side a little more distinct and another short band of pale spots inwardly paralleling the lower part of the other band. Lightly overscaled with fulvous, especially in the abdominal fold.

Head and thorax above brown, a few fulvous scales on the head. Palpi missing. Pectus brown and fulvous. Thorax beneath brown. Abdomen above brown; beneath brown with a little fulvous in the center. Antennae above and beneath blackish, the club yellowish beneath.

Expanse.—40 mm.

Types.—Holotype male, Banos, Ecuador.

Pholisora inornata, new species

Figure 7

This is one of the smaller members of the genus and bears no close resemblance to any of the other described species with which the writer is familiar.

Upper side of the wings brown, without dark bands or spots and no subapical spots on the primaries. The primaries are sparsely overscaled with pale fulvous. Secondaries with some long fulvous hairs. Both wings have a somewhat darker terminal line. Fringes a little paler than the ground color of the wings. No costal fold on the primaries. Outer margin of secondaries rounded, with no excavation.

Beneath paler than above; no dark bands on either wing. Primaries broadly yellowish white along inner margin except at the inner angle. Both wings overscaled with pale fulvous and both have a dark terminal line.

Upper side of head and body dark brown and a little fulvous. Palpi missing. Thorax beneath with long fulvous brown hairs. Abdomen beneath brownish fulvous. Antennae black above; beneath spotted with yellow; club missing.

Expanse.—28 mm.

TYPE.—Holotype male, Ecuador.

Pholisora putumayo, new species

Figure 9

A small species somewhat resembling *aurocapilla* Staudinger but from which it may be immediately distinguished by the presence of the additional small white spots on the primaries mentioned in the following description.

Above dark brown. Primaries with three small, hyaline, subapical spots, the central one slightly inward of the other two; and the following minute white spots: one in the cell on the upper border near the end; one in the basal quarter of interspace 3, very minute; one in the basal quarter of interspace 2, a little larger but still minute; one almost directly beneath in the center of interspace 1 and about the same size; a slightly paler brown spot in the end of the cell; a curved row of paler brown spots from near costa, outside of the subapical spots, to vein 1; these paler spots and the pale cell spot bound a faintly discernible dark band through the cell from the costa to vein 1 and another dark, curved band, enclosing the subapical hyaline spots, from the costa to vein 1; the outer margin has a dark border. A prominent costal fold is present. Secondaries rounded, no excavation in the outer margin; an outer band, discal band and minute basal spot, all paler brownish; some indistinct, paler marginal streaks between veins. Fringes of both wings blackish brown. Both wings sparsely overscaled with pale fulvous.

Beneath a little paler. Primaries with costal, outer and inner marginal areas paler than the rest; a small, indistinct, pale transverse streak in the cell; the outer row of spots less prominent than above; a few pale fulvous scales at the apex. The three subapical spots are repeated but none of the other white spots are present beneath. Secondaries with a minute basal spot; a transverse streak in the cell; and an outer irregularly curved row of spots, the lower three the most distinct, all formed of accumulations of pale fulvous scales and not well-defined spots; a very scattered overscaling of pale fulvous, mostly at base, abdominal fold and anal angle.

Top of head and collar golden; shoulder covers brown sprinkled with golden; tegulae brown. Palpi missing but beneath were probably fulvous as indicated by the few remaining hairs. Abdomen above and beneath brown. Pectus and thorax beneath brown and fulvous. Antennae black above; beneath minutely spotted with pale fulvous, the club yellowish.

Expanse.—29 mm.

TYPE.—Holotype male, Putumayo River, Peru.

Pholisora aplica, new species

Figure 15

This species somewhat resembles *giselus* Mabille in general appearance but may be distinguished therefrom by the absence of the costal fold on the primaries of the male.

Upper side of both wings rusty brown. Primaries with the usual dark bands scarcely visible, one across the cell and one from the costa around the cell end to vein 1; one specimen, the type, has a single small, hyaline subapical spot in interspace 8; another specimen has one in each of interspaces 6, 7 and 8; and a third specimen has one in each of interspaces 7 and 8. Fringes slightly paler than the ground color of the wings. Secondaries have two bands of small pale spots, one discal and the other between it and the margin; a transverse streak in the cell; a minute spot toward the base of the wing, all of which are very indistinct; a sparse overscaling of fulvous heaviest along abdominal fold and in anal area. Fringes same as on primaries. Outer margin rounded, with no excavation.

Under side paler than above. Primaries with outer margin and the inner margin particularly toward the base paler than the rest of the wing; the dark bands of the upper side still more indistinct; the subapical spots are repeated but only the one in interspace 8 is clearly seen. Secondaries with the bands of pale spots of the upper side more reduced; a slight overscaling of fulvous especially along abdominal fold and at anal angle.

Top of head and body brown and fulvous. Palpi beneath and pectus fulvous or brown and fulvous. Thorax and abdomen beneath fulvous or brown and fulvous. Antennae above black; beneath variably spotted with yellow fulvous, the club entirely fulvous, reddish on the side of the apiculus.

Expanse.—34–36 mm.

TYPE.—Holotype male, Chilpancingo, Guerrero, Mexico; two male paratypes, San Jose, Costa Rica, 3900 feet, August 4.

Pholisora balsa, new species

Figure 13

This insect is somewhat like *mazans* Reakirt but there are no hyaline spots on the primaries and the secondaries are rounded with no excavation in the outer margin.

Primaries of the male dark brown; a large black spot occupying the basal two-thirds of the cell and below it to vein 1; an irregular, curved black band extending from the costa around the cell end to vein 1; the part from vein 3 to vein 1 broader than the upper part; a black marginal border. Fringes blackish. Outer half of wing overscaled with pale fulvous and yellowish white. Costal fold present. Secondaries black in basal third; a black discal band outwardly bordered by a bent row of pale spots composed of accumulations of pale fulvous and yellowish white scales; a black marginal border. Fringes blackish.

Beneath.—Primaries paler than above; the black bands of the upper side indistinctly present; inner margin narrowly paler; a few fulvous scales near the apex. Secondaries blackish in the basal quarter; outer three-quarters dark brownish; a black discal band curved from costa to abdominal fold, broadest above the cell, and bordered by a row of pale spots composed of accumulations of pale fulvous scales, the lower three or four being the most prominent and these are paralleled inwardly by three or four similar spots; a few fulvous scales near the border below vein 3.

Top of head and body black with a very few fulvous scales. Palpi beneath black and fulvous. Pectus black. Abdomen beneath black. Antennae above and beneath black, the club beneath brownish.

Female similarly marked but paler and more heavily overscaled on both wings, the black bands more prominent; the fulvous overscaling on the black marginal bor-

der of the primaries causing the appearance of a band of triangular black spots; on the secondaries the black marginal band is broken up into spots. The overscaling of fulvous extends onto both sides of the thorax and abdomen. Beneath a little paler than the male. Primaries with more fulvous scales at the apex and extended along the entire costa to the base. Secondaries with heavier overscaling at the base, abdominal fold and inner marginal half of the wing. The antennae above and on the sides with an overscaling of fulvous and both the shaft and the club are fulvous beneath.

Expanse.—Male, 30 mm., female, 31 mm.

Types.—Holotype male, Balsapuerto, Peru; allotype female, Yumbatos, Peru.

Pholisora (?) *angulata*, new species

Figure 14

This species is possibly not congeneric with the others, the inner margin of the primaries is curved inwardly in the center, producing a distinct lobe at the inner angle of those wings and the outer margin of the secondaries is slightly excavated above the anal angle and between veins 4 and 6 thus giving the appearance of a slight projection in the middle of the wing. The form of the male genitalia is, however, close to that of *Pholisora*.

Upper side of both wings brown with a variable overscaling of sordid whitish. Primaries with a darker band from upper edge of the cell to vein 1; a band curved around the cell end to vein 1; a marginal band which contains still darker spots between the veins; these markings are very indistinct in one specimen; three hyaline subapical spots, the middle one a little out of line inwardly, the upper spot the largest, the lower the smallest; a small hyaline spot in the cell on the upper margin near the end. In addition to the lobe at the inner angle there is a slight excavation in the outer margin between veins 1 and 2. The fringes are brown, a little darker at the end of the veins, except between veins 1 and 2 where they are paler brownish, and they have a narrow, black basal line. Secondaries dark at the base; a sub-basal dark band, forked between veins 7 and 8; a dark discal band; a submarginal band of dark spots, rather indistinct. Fringes brown, darker at end of veins and with a narrow, black basal line.

Beneath paler than above. Primaries with the bands of the upper side indistinctly repeated in two specimens, more prominently in the third; the hyaline subapical spots repeated; an ochreous spot at the apex, composed of an accumulation of scales of that color; a little overscaling of sordid whitish, much heavier in one specimen. Secondaries with the bands of the upper side but less distinct, in one specimen more prominent than the others; the sordid whitish overscaling heaviest in the abdominal fold.

Top of head, thorax and abdomen brown variably intermixed with sordid whitish. Palpi above blackish brown and fulvous, beneath, and the pectus, brown heavily intermixed with sordid whitish or yellowish white scales. Thorax with long hairs of similar color. Abdomen brown. Antennae above blackish, beneath variably spotted with fulvous, the club fulvous.

Expanse.—32 mm.

Types.—Holotype male, Sul de Minas, Brasil; two male paratypes, Itatiaya, Brasil, and Marumba, Brasil.

Heliopetes leca Butler

Pyrgus leca BUTLER, 1870, Trans. Ent. Soc. London, p. 510. Venezuela.

Erynnis laviana HAYWARD (not Hewitson), 1933, Revista de la Sociedad Entomologica Argentina, V, p. 271; Pl. XXI, fig. 8, Pl. XXX, fig. 4.

Butler's *leca* has long been placed by authors as a synonym of *laviana* Hewitson, however, in his original description Butler mentions a white ray on the under side of the secondaries which extends from the outer margin through the cell to the V-shaped basal spot. This ray is not mentioned by Hewitson in his original description of *laviana* (1868, 'Descriptions of One Hundred New Species of Hesperiidæ,' part 2, p. 48) and is not shown in his subsequent figure of that insect (1875, 'Exotic Butterflies,' V, *Leucochitonea* Pl. II, figs. 15, 16).

In addition to the white ray mentioned there are other superficial characters readily separating *leca* from typical *laviana*. On the upper side of the wings *leca* is glistening white, much more so than *laviana* and on the under side of the secondaries the inner edge of the darker colored outer marginal area is always deeply indented opposite the cell, this latter character being more noticeable in those individuals having the white ray poorly developed; when the white ray is well developed the inner edge of the dark marginal area is obliterated where the ray passes through it. In *laviana* the inner edge of the dark marginal area is always an approximately straight, even line for the entire length.

Leca was described from material from Venezuela, and specimens examined from that country, Colombia, Peru, Argentine, Paraguay, and southern Brasil all agree with the characters mentioned by Butler. *Laviana* was described from material from Nicaragua, and specimens from southern Texas, Mexico and Central American localities all agree with the characters of Hewitson's description and figures.

As the form of the male genitalia is the same in both insects it is probable that *leca* represents merely a well-defined southern race of *laviana* but there are sufficient and constant superficial differences between the two insects to warrant retaining the name *leca* for the southern form.

In The American Museum of Natural History collection there is a series of three males and five females from La Rioja, Argentine, which are smaller than the general average and have the dark areas and spots of the upper side of the primaries more brownish and not the usual blackish brown and in the males the usual broad dark apical area of these wings is reduced to a small brownish apical patch and only the fringes and the tips of the veins are brown. These males present a very glistening white appearance.

***Pyrgus domicella* race *margarita*, new race**

Differs from typical *domicella* in the very reduced white areas of both wings.

Male has the median white band of the primaries very narrow and sparsely strewn with brown scales; the four subapical spots are minute; the white spot near the base of interspace 3 and the two in interspaces 4 and 5 are small, ill-defined and intermixed with brown scales; the usual row of white submarginal spots is either entirely absent or represented by a few white scales; the marginal row is entirely absent; all the rest of the wing is brown. On the secondaries the white median band is narrow, ill-defined and heavily overscaled with brown; the usual submarginal row of spots is reduced to three small, ill-defined spots, overscaled with brown, near the anal angle; the rest of the wing brown.

On the under side the bands of both wings are a little broader and more clearly defined, although the median band of the secondaries is pale, smoky brown. The subapical spots and the two in interspaces 4 and 5 are larger and more prominent than on the upper side.

Female has the median band of both wings a little broader and less overscaled with brown than the male and the other spots of both wings are better defined, though all are reduced from the typical form.

Expanse.—Male, 34 mm., female 37 mm.

Types.—Holotype male, and allotype female, Margarita Island, Venezuela.

***Erynnis quadratus* Dyar**

Thanaos quadratus DYAR, 1926, Insec. Menstr., XIV, p. 142. Colima, Mexico.

The type in the National Museum in Washington is a female and a member of the genus *Pholisora*. It appears to be either the same as *azteca* Scudder or a very similar species.

AMERICAN MUSEUM NOVITATES

Number 915

Published by
THE AMERICAN MUSEUM OF NATURAL HISTORY
New York City

April 10, 1937

BIRDS COLLECTED DURING THE WHITNEY SOUTH SEA EXPEDITION. XXXIII¹

NOTES ON NEW GUINEA BIRDS. I

By ERNST MAYR

I have been working on a list of New Guinea birds for a period of more than seven years. In order to present more than a compilation it was found necessary to revise critically every genus occurring in that region. The results of these revisions have been published in previous papers as far as passerine birds are concerned. Most of the non-passerine species, however, extend their range considerably beyond New Guinea, and revisions of these species could not have been undertaken without consulting the rich material of the Rothschild Collection and the extensive collections of the Whitney South Sea Expedition made in the Bismarck Archipelago, the Louisiade and d'Entrecasteaux Archipelagoes, the Solomon Islands, and Polynesia. It was thought best to include these revisions in the present series, since a considerable portion of the examined material was collected by the Whitney Expedition.

The present paper contains a study of the genus *Collocalia*. No list of the New Guinea birds could be prepared without a critical revision of the vast amount of new material of this genus accessioned by the American Museum during recent years. The variation and the relationship of the New Guinea species cannot be understood without reference to the extralimital species. Still, the emphasis of the following revision is on the New Guinea forms, and all the others are treated only incidentally. I am deeply obliged to Dr. E. Stresemann for much advice and for the loan of valuable material, including the type of *pseudovestita*.

NOTES ON THE GENUS *COLLOCALIA*

Every author who has ever worked with these small swiftlets of the Indo-Australian region will contend that their classification presents the most difficult problem in the taxonomy of birds. The members of this genus live in large or small colonies, frequently in inaccessible caves, and

¹ Previous papers in this series comprise American Museum Novitates, Nos. 115, 124, 149, 322, 337, 350, 358, 364, 365, 370, 419, 469, 486, 488, 489, 502, 504, 516, 520, 522, 531, 590, 609, 628, 651, 665, 666, 709, 714, 820, 828, and 912.

every population is slightly different from the next one. They are difficult to collect and not one of the museums of the world has adequate material. To make matters worse, most of the species are of practically the same dull sooty gray coloration with almost the same development of the structural characters (such as bill, feet, wing-formula, etc.). (See Stresemann, 1932, Bull. Raffl. Mus., No. 6, pp. 83-84.)

The time has not yet come to undertake a final satisfactory classification of the genus, because the material at hand is still insufficient for the correct description of the more difficult forms and for the understanding of the natural relationships. On the other hand, the American Museum has recently received so much new material, that it has seemed advisable to examine it in the light of the recent revisions. These studies have been carried on by me for more than three years and no final conclusions have yet been reached. It has, however, been possible, to clear up some doubtful points and to make certain observations which will help future workers. This has encouraged me to publish the results of my studies although they are admittedly of a preliminary and incomplete nature.

The literature on this genus illustrates exceedingly well the trends of ornithological classification. We see in the earlier part of this century conscientious efforts to analyze the characters of the various geographical races without much of an effort to combine the many disconnected units into natural groups of related forms. Oberholser's papers were written in this analytical stage. In opposition to this trend the Formenkreislehre gained increasing influence during the twenty's, emphasizing the principle of geographical representation frequently with disregard of a thorough morphological examination of the treated forms. During this period (1925-1926) Stresemann proposed a classification of this genus, which grouped all the then known forms in six species: *francica*, *fuciphaga*, *gigas*, *troglodytes*, *esculenta*, and *brevirostris*. A reaction to this ultra-synthetic trend was inevitable, and Stresemann himself was the first to suggest the breaking up of these large Formenkreise into smaller, but more natural species. His recent papers (1932, Bull. Raffl. Mus., Singapore, No. 6, pp. 83-101, and 1932, Novit. Zool., XXXVIII, pp. 164-170) are the starting points of my work, which fully confirms his conclusion that the white-rumped forms of the Australian region should be separated specifically from *francica* as *spodiopygia*, and that the dark-rumped forms should be separated from *fuciphaga* as *vanikorensis*. I disagree with Stresemann in regard to the arrangement of the following forms: *baru*, *hirundinacea*, *excelsa*, *infuscata*, *ceramensis*, *sorum*, and *terraereginae*, all of which I remove from *vanikorensis*.

I fully agree with Stresemann's recent conclusion (1932, Bull. Raff Mus., No. 6, p. 93) that the natural consequence of the recent studies of this genus is, to break it up into a greater number of species. Reviewers of this genus have too frequently forgotten the principle that whenever closely related species break up into numerous subspecies (as *Collocalia*!), the genus to which they belong almost always also breaks into numerous species. The widely distributed genus *Collocalia*, which ranges from the Madagascar region to the Marquesas Islands (practically halfway around the world) is no exception to this rule. Instead of six species, as Stresemann thought in 1925, it probably contains more than fifteen. The mere fact that such exceedingly similar forms occur together at the same localities as *hirundinacea* and *vanikorensis* in New Guinea, as *natunae*, *germani*, and *mearnsi* in the Borneo region, as *javensis* and *fuciphaga* in Java, and as *amelis* and *mearnsi* in the Philippines, should be a sufficient warning against grouping in one species anything but very similar forms.

I have seen but very little material of the forms occurring on the islands of the Indian Ocean, as well as of those occurring on the Asiatic continent and the Greater Sunda Islands. I shall therefore leave most of them out of the discussion at the present time. They will be reviewed in greater detail at a later occasion. I shall also omit any reference to such well-defined species as *esculenta*, *troglodytes*, *gigas*, *whiteheadi*, and *lowi*. They are so different that they are not likely to be confused with those forms that are usually listed as subspecies of *fuciphaga*, *francia*, and *vestita*.

Like Stresemann (*loc. cit.*, p. 85) I am using in addition to the length of wing and tail, also the "tail-furcation" (difference of length between the shortest and the longest tail-feather) and the "tail-index" which is the length of the longest tail-feather multiplied by 100 and divided by the length of the wing. I have also attempted to introduce several new morphological characters into the discussion of the various subspecies, such as size and shape of the bill, structure of the feathers of crown and throat, and the presence or absence of white downy tips to the bases of the feathers of the back. Additional features could probably be found at a still closer and more patient examination of these birds.

Collocalia leucophaea (Peale)

This large dull colored species stands quite by itself. It is characterized by its soft fur-like plumage, by its long tail (index up to 50), by the reduction of the supraloral spots, by its black under tail-coverts,

and many other features. *C. l. ocista* Oberholser is very similar to the typical form in general coloration, but differs in many other respects. A detailed revision of this species is in preparation.

RANGE.—Society and Marquesas Islands.

Collocalia vanikorensis (Quoy and Gaimard)

I had measured up most of our material of this species already several years ago and had made detailed notes on the populations of the different islands. A more intensive study of the genus *Collocalia* has finally convinced me, that there is no better way to come to definite conclusions concerning the taxonomy of this difficult genus than by the careful analysis and description of the known populations. There are only two alternatives in treating this species: either we recognize no races at all and sink *moluccarum*, *yorki*, *steini*, and *waigeuensis* in the synonymy of *vanikorensis* or else we give each circumscribed population a subspecific name. Following the precedent set by Stresemann, I follow the latter course.

During the preparation of this review I have examined 213 specimens of the subsequently discussed forms, including all the types, with the exception of that of *vanikorensis* Quoy and Gaimard which is in the Paris Museum. The amount of collecting done in recent years is best illustrated by the fact that I had before me 213 specimens of the one species *vanikorensis*, while Oberholser had at his disposition only 159 specimens of all the species of *Collocalia* when he wrote his first monograph of the genus in 1906.

Collocalia vanikorensis vanikorensis (Quoy and Gaimard)

Hirundo vanikorensis QUOY AND GAIMARD, 1830, 'Voy. "Astrolabe,"' Zool., p. 206, Pl. xii, fig. 3.—Vanikoro Island, Santa Cruz Archipelago.

A large dark form; back almost as dark as crown and with a greenish (or purplish in worn plumage) gloss; rump not appreciably lighter than back; upper throat very light and strongly contrasting with dark abdomen; shaft-streaks on abdomen more or less pronounced; ear-coverts dark, contrasting with the light throat; loreal spots medium sized and not conspicuous; under wing-coverts pure black or with inconspicuous pale edges; tarsus reddish brown and always bare; white¹ on back much reduced; bill large and not strongly curved; tail long (index usually above 40); strongly furcated.

RANGE. New Caledonia, New Hebrides, Santa Cruz Islands, Reef and Duff groups, and Solomon Islands.

¹ "White on back" means the presence of white downy tips to the rami of the basal part of the feathers of the back and to the after shafts of these feathers.

There is little doubt that I have united under this name a somewhat heterogenous assemblage of populations, but the material at hand is not in a sufficiently good condition to permit any further subdivision at the present time. Old skins, that is skins which are in collections for more than 8 or 10 years show already definite signs of "foxing." The upper parts turn lighter and more brownish and the under parts also more brownish and dirtier. Still more important are differences between freshly molted and very worn specimens. Fresh birds are darker and more greenish above and on the wings, worn birds more bluish or purplish, the feathers above the eye and the under wing-coverts sometimes acquire pale edges through wear, and the under parts may become very brownish and soiled during the breeding season. Immature birds are also different from adults. Although it is impossible always to tell them apart, young birds seem to differ by smaller size, less furcation of the tail, broader primaries, less glossy plumage, pale edges to the secondaries (in fresh plumage), broad soft edges to the feathers of the rump, more pronounced pale margins to the feathers above the eye and at the wing-bend, and by the generally smaller size. To give a correct description of each subspecies one must keep all these variations in mind.

I shall now give a more detailed discussion of the various populations combined under the name *vanikorensis*, to indicate where future division will have to be made, after more material has become available.

NEW CALEDONIA.—No material available. Our knowledge of the occurrence of the species is based on sight records (Layard, Ibis, 1878, p. 253, and id., Ibis, 1882, p. 503).

ERROMANGO, NEW HEBRIDES.—Two immatures examined (L. Macmillan). Both rather pale underneath, one with a few white (albinistic) feathers on the abdomen.—Wing 121, 126; furcation 7, 7; index 44.7.

EFATE.—3 specimens. Wing 119–125; furcation 7–10; index 45.2.

EPI.—5 specimens. Wing 119–125; furcation 8–11 (9.0); index 46.4.

SANTO.—12 specimens. Wing 116–124 (119.7); furcation 7–11 (8.4); index 46.1.

VANUA LAVA.—2 specimens. Wing 120, 122; furcation 8.5, 9; index 45.9.

REEF-DUFF Is.—4 specimens. Wing 115–118 (116.8); furcation 7–8 (7.5); index 46.4.

Additional specimens were obtained at Tongoa, Aoba, Pentecost, Malekula, and Dolphin Island.

It is evident from these measurements that in southern Melanesia there is a gradual decline in size as we go north toward the equator. There are unfortunately no specimens available from Vanikoro, Santa Cruz Islands, the type-locality of this subspecies.

SOLOMON ISLANDS.—There are several populations recognizable, some dark (Vella Lavella, Choiseul), some light (Santa Anna), some variable or intermediate (Guadalcanar, Bougainville, Ugi). All these birds have, however, similar proportions. The wing never goes above 117.5 (average 114.4), the tail is medium (index 44.1), and the furcation is slight (5–8, av. 6.1).

These measurements and proportions are quite different from those of the New Hebrides birds. More material from the Santa Cruz Islands is needed to decide whether or not it is worthwhile to describe a new race.

Collocalia vanikorensis subspecies

RANGE.—Bismarck Archipelago.

A large series collected at Wide Bay was unfortunately collected within one week and practically all specimens are molting or immature. The wing seems to vary between 117 and 126, with an average of about 120, which agrees well with some measurements recorded by Stresemann (1923, Arch. Naturgesch., LXXXIX, A, fasc. 8, p. 28), the tail furcation is about 7–9 (7.9), and the tail-index 42–44. In coloration it is similar to *vanikorensis*, but slightly lighter above and below, particularly on upper throat and ear-coverts, the white supraloral spot seems to be larger and the pale edges on the under wing-coverts more pronounced.

Quite similar in coloration and proportion is a series of 8 birds collected by Eichhorn on New Hanover, in March, 1923. Wing 118–123 (120.0), furcation 7–9 (7.8), tail-index 43.0.

Collocalia vanikorensis *lihirensis*, new subspecies

TYPE.—No. 335906, Amer. Mus. Nat. Hist.; ♀ ad.; Lihir Island, Lihir group near New Ireland; September 15, 1934; William F. Coultas.

A large dark form. Similar to *vanikorensis*, but larger and with a bigger bill; upper parts darker and more greenish; supraloral spot larger; shaft-streaks on under parts more pronounced; more white on back (see footnote, p. 4).

Ten males, wing, 119–127 (123.9), furcation 7–10 (8.5), tail-index 45.6; twelve females, wing, 121–129 (124.0), furcation 6–9 (8.0), tail-index 45.1.

RANGE.—Islands northwest of New Ireland (Lihir, Tabar, and St. Matthias).

A single male from St. Matthias (120, 9, 45.5)¹ and two males from Tabar Island (123.5, 9.5, 45.3) are still darker, particularly on the belly, but agree in their proportions quite well with *lhirensis*.

***Collocalia vanikorensis coultasi*, new subspecies**

TYPE.—No. 334780, Amer. Mus. Nat. Hist.; ♀ ad.; Malai Bay, Manus, Admiralty Islands; January 3, 1934; William F. Coultas.

A large, light form. Under parts with a somewhat silvery appearance, abdomen only slightly darker than throat; back paler than crown; rump much paler than back; in worn specimens almost whitish; ear-coverts rather light; a great deal of white on the back (see footnote p. 4); shaft-streaks on abdomen variable; supraloral spots medium; crown and wings rather bluish; tail not long, but well furcated.

Wing (7 specimens), 121–130 (124.7), furcation 6–11 (8.0), tail-index 43.3–44.6.

RANGE.—Only known from the type-locality.

A series from Rambutyo Island (March, April, 1934, Coultas coll.) is similar to *coultasi* but not quite as light and with the rump only slightly lighter than the back. Most specimens are, unfortunately, immature and the measurements therefore inconclusive (121.0, 8.2, 45.5).

***Collocalia vanikorensis tagulae*, new subspecies**

TYPE.—No. 450941, Amer. Mus. Nat. Hist. (Rothschild Collection); ♀ ad.; Sudest (= Tagula) Island, Louisiade Archipelago; May 3, 1916; A. S. Meek.

A large, light form. Abdomen only slightly darker than throat, shaft-streaks variable, upper parts more greenish than in *vanikorensis*, back paler than crown; rump as dark as back; ear-coverts not very dark; pale edges of under wing-coverts pronounced; not much white on back; supraloral spot small; size large, tail long and deeply furcated.

Wing 124–129 (126.2), furcation 9–12 (10.1), index 45.5.

RANGE.—Sudest (= Tagula) Island, Louisiades.

A series of six birds from Misima (= St. Aignan) is quite similar in coloration, but size and proportions are different.

Wing, 122–124 (123.2), furcation 7–10 (8.3), index 43.8.

It seems best to include these birds with *tagulae*. Two males from the Trobriand Islands (117.5, 10.0, 47.0) and two females from Woodlark Island (117.0, 10.0, 46.2) are similar to *tagulae*, but slightly darker, particularly on the abdomen. Their extraordinary proportions (short wing, but long and deeply furcated tail) seem to indicate that they belong to an undescribed race. The meagerness of the material, particularly the fact that one of the specimens is molting and two of them are apparently in immature plumage makes it undesirable to name this form.

¹ The three figures in the parenthesis in this and other instances indicate the average of wing-length, of tail-furcation, and of the tail-index.

Collocalia vanikorensis granti, new subspecies

TYPE.—No. 450940, Amer. Mus. Nat. Hist. (Rothschild Collection); ♂ ad.; Setekwa River, Dutch New Guinea, August 4, 1910; A. S. Meek.

A small, light form. Rather similar to *tagulae*, but a little darker, both above and on the abdomen; much lighter than *steini* or *waigeuensis*; tarsus usually bare, sometimes a few scattered feathers on the upper end of the tarsus; very little white on back (see footnote p. 4); pale edges on under wing-coverts usually present; supraloral spot medium; ear-coverts rather dark; bill large; upper parts distinctly greenish, back hardly paler than crown, rump as dark as back.

Wing, 115, 115.5, 116.5; outermost tail-feather 48.5, 49, 49; furcation 6.5, 6.5, 7; tail-index 42.2.

RANGE.—Lowlands of southern and eastern New Guinea; Ferguson Is.

I name this race in honor of the late Ogilvie-Grant, who was the first ornithologist to recognize the specific distinctness of *Collocalia vanikorensis* and *hirundinacea*.

I have chosen the Setekwa River as type-locality for this subspecies because there is material from that district in several European museums.

Other New Guinea populations of this species do not completely agree with the type series, but they all agree in a fairly or very light coloration of the under parts, small size, shortness and slight furcation of tail.

A series of six birds from Bioto, Baroka Creek (near Hall Sound, southeast New Guinea) is quite similar to *granti*, but slightly darker above and below; size larger, wing 117–120 (118.2), furcation 6–10 (av.?), tail-index 42.5. Several specimens are molting or immature and the proportions are not quite certain.

A series of five birds from the neighboring mountains (Mafulu, Central Division) is larger, darker and in many ways more similar to typical *vanikorensis* than to *granti*; the under parts average, however, definitely paler and the upper parts more greenish; tail-furcation and tail-index are those of *granti*.—Wing, 118–123 (120.2), furcation 6–9 (7.6), tail-index 42.8.—This difference between a lowland and a highland population is another case of altitudinal variation (see Rand, 1936, Amer. Mus. Novit., No. 890).

A single ♀ from Keku, near Astrolabe Bay, is a little darker on crown and wings but otherwise like *granti*.—Wing, 120.5, furcation 7.5, index 41.5.

Four specimens from Japen (Serui 3, valley beyond Serui 1) are completing their molt and only one can be measured (118, 8.5, 42.4). They

agree with *granti* in the coloration of the under parts, but are darker above which may partly be due to the freshness of the plumage.

A single freshly molted male from the lower Menoo River (Weyland Mts.) is very dark both above and below.

A single female from Manokwari (in molt) agrees fairly well with *granti*. Further observations on some of these specimens can be found in Novit. Zool., XXXVIII, (1932), pp. 164-169, although Stresemann does not separate *vanikorensis* and *hirundinacea* in two species.

A single male from Fergusson Is. (A. S. Meek Coll.) agrees very well with the typical series of *granti*. It is still lighter underneath, the pale edges of the under wing-coverts are very pronounced and the supraloral spot is large (117, 7.5, 43.6).

Collocalia vanikorensis steini Stresemann and Paludan

C. vanikorensis steini STRESEMANN AND PALUDAN, 1932, Novit. Zool., XXXVIII, p. 167.—Numfor Is., Geelvink Bay.

A medium-sized dark race. In coloration very much like *vanikorensis*, but tail apparently slightly shorter; wing (of not molting specimens) 115-123 (118.2), furcation 5-12 (9.0), tail-index 44.5.

RANGE.—Numfor Island.

Collocalia vanikorensis waigeuensis Stresemann and Paludan

C. vanikorensis waigeuensis STRESEMANN AND PALUDAN, 1932, Novit. Zool., XXXVIII, p. 168.—Waigeu Island.

A small dark race, in coloration like *moluccarum*, *steini* and *vanikorensis*, but smaller and with a very short tail.

Wing 109-112 (110.3), furcation 5-8 (6.8), tail-index 41.3.

RANGE.—Waigeu Island.

Collocalia vanikorensis yorki Mathews

Collocalia francica yorki MATHEWS, 1916, Bull. Brit. Orn. Club, XXXVI, p. 77.—Cape York.

A medium-sized, rather dark form. The unique type is about intermediate in coloration between *vanikorensis* and *granti*. Wing 120, tail 45/55, furcation 10, tail-index 45.8. More material is needed to characterize *yorki* more completely, particularly in comparison with *moluccarum*, *steini*, and *vanikorensis*:

RANGE.—Cape York Peninsula, Queensland.

Collocalia vanikorensis moluccarum Stresemann

Collocalia fuciphaga moluccarum STRESEMANN, 1914, Verh. Orn. Ges. Bayern, XII, p. 7.—Banda Is., Moluccas.

A small dark form; back almost as dark as crown, and with a bluish-green gloss; rump not lighter than back; tarsus bare; abdomen distinctly darker than throat,

shaft-streaks not very pronounced; ear-coverts dark; supraloral spots large; under wing-coverts usually with conspicuous pale edges; little white on back (see footnote p. 4); bill large and fairly curved.

Wing 111.5, tail 42/51, furcations 9, tail-index 45.7.

RANGE.—Banda Is., Moluccas.

Populations, identified as *moluccarum*, have been recorded from a great many islands of the Moluccas and neighboring groups: Kei Islands, Kor, Goram, Ambon, and Morotai. I have seen only a few specimens from this large area, and I do not know whether or not all these birds really belong to *moluccarum*.

A series of six specimens from Koer Island is larger than the Banda bird (wing 116-120 (117.1), furcation 7-9 (8.0), tail-index 45.6). Six specimens from the Little Key Islands agree in coloration with *moluccarum*, but are worn and molting and cannot be measured.

In the Lesser Sunda Islands, not far from the Moluccas begins the range of a different, but similar species, that of *Collocalia* "*germani*," in the form *micans* Stresemann. It differs from *C. vanikorensis moluccarum* by having the tarsus frequently feathered, by having a smaller bill, by having much white on the back, by having the belly pale and not distinctly darker than the throat, and by having the crown much darker than the back, and consisting of smaller feathers.

Collocalia vanikorensis aenigma Riley

Collocalia vestita aenigma RILEY, 1918, Proc. Biol. Soc. Washington, XXXI, p. 156.—Parigi, north central Celebes.

A fairly large, not very dark race. Quite similar to *moluccarum*, but contrast between throat and abdomen more pronounced; shaft-streaks on abdomen conspicuous; coloration of upper parts darker and even in fresh specimens slightly more bluish, less greenish, in worn specimen very bluish; rump not, or only slightly paler than back; ear-coverts dark; loreal spots small and not conspicuous; under wing-coverts and often also the superciliary feathers with broad pale edges; tarsus bare or with a few scattered feathers near the upper end; very little white on back; tail short and not much furcated.—Wing, (14 specimens) 114-123 (119.0), outer tail-feather 47-52 (49.4), furcation 5-9 (6.4), tail-index 41.5. (The specimens recorded by Stresemann, 1932, Bull. Raff. Museum, No. 6, p. 92 have the following tail-indices: 39.2, 41.8, 42.1, 42.4, and 43.9.)

RANGE.—Central Celebes and southeastern Celebes.

This is the fourth species with which this unfortunate form is being classified, after having been listed by Riley and Stresemann as subspecies of *vestita*, *fuciphaga*, and *francica*.

The relationship with *vanikorensis* is, however, quite obvious. It agrees with it in all the important specific characters: tarsus bare, feathers of crown large and not much darker than back, bill large and

not strongly curved, very little white on back (see footnote p. 4), feathers of abdomen differing from those of throat very markedly in structure and color. It differs from most forms of *vanikorensis* by its relatively short tail with only a slight furcation. It agrees in this respect with *C. v. granti* and *waigeuensis*.

***Collocalia vanikorensis heinrichi* Stresemann**

Collocalia francica heinrichi STRESEMANN, 1932, Ornith. Monatsber., XL, p. 110.—Talassa (Maros), south Celebes.

Very similar to *aenigma*, but abdomen lighter and grayer, upper parts more greenish; size smaller.

Wing 113, tail 42/47.5, furcation 5.5, tail-index 42.0.

RANGE.—South Celebes.

The greenish coloration of this specimen is partly due to the fact that it is quite fresh, while the series of *aenigma* examined by Stresemann is worn and molting. But even the fresh feathers of *aenigma* are more bluish than those of *heinrichi*.

Collocalia inquieta

Three similar forms of *Collocalia* are known from the Caroline Islands, *inquieta* Kittlitz from Kusaie, *rukensis* Kuroda from Ruk, and *ponapensis* Mayr from Ponape. The principal difference between the three forms is size. All three are similar to the species of *vanikorensis* group and a more detailed examination will probably prove that they belong to that species. At the time being, it seems advisable to treat it as a separate species, particularly in view of the fact that most other widespread genera (*Ducula*, *Gallicolumba*, *Ptilinopus*, *Halcyon*, *Aplonis*, *Myzomela*, and *Zosterops*) are represented in the Caroline Islands by endemic species.

Collocalia hirundinacea

All gray swiftlets of the genus *Collocalia* with a dark rump were until very recently considered subspecies of the Javanese *fuciphaga*. When Stresemann described, in 1914 from southwest New Guinea, a small population with silvery gray under parts and more or less feathered tarsus as *hirundinacea*, it was only natural that he regarded it also a subspecies of *fuciphaga*. Already in the following year (1915), however, Ogilvie-Grant pointed out that there were really two similar species living side by side, one which he called *C. fuciphaga vanikorensis* (= *C. vanikorensis granti* Mayr) and one which he admitted as good species: *C. hirundinacea* Stresemann. Although this was perfectly correct, it was ignored by subsequent workers on Papuan birds (Hartert, Strese-

mann, and others) with the result that all sorts of confusions occurred. As a matter of fact, even the typical series of *hirundinacea* from the Setekwa River contains both species, but the actual type specimen belongs to the species with feathered tarsus, so there can be no doubt about the name *hirundinacea*. In 1923 Stresemann named *pseudovestita* which according to the original description combines the coloration of *vanikorensis* with the feathered tarsus of *hirundinacea*. Again it was a mixed population, the type belonging to the feathered species *hirundinacea* and the paratype collected on the same day and locality (Jan. 11, 1901, Madang, Astrolabe Bay, O. Heinroth) belonging to *vanikorensis*. In 1932 Stresemann and Paludan were puzzled by the fact that Stein collected two very different populations on Japan Island. Again they belonged to the two species. The specimens collected at Kampong Baru and described as *C. vanikorensis baru* belonged to *C. hirundinacea*, and the specimens collected at Serui and recorded as *C. vanikorensis hirundinacea* belonged to *C. vanikorensis*. In 1933 when I was identifying the collections made by R. H. Beck at the Astrolabe Bay and on the Huon Peninsula, I became convinced that there were two species, and Dr. A. Rand came independently to the same conclusion while he was undertaking the preliminary identification of the birds of the Archbold-Rand 1933 New Guinea Expedition. The splendid material gathered by this expedition permits no longer even the slightest doubt as to the specific distinctness of *vanikorensis* and *hirundinacea* (see Mayr and Rand, 1937, Bull. Amer. Mus. Nat. Hist., LXXIII, p. 77).

Of all the subspecies of *vanikorensis* the one that has the same range as *hirundinacea* is also most similar to it in coloration as well as measurements and proportions. To facilitate the identification of these gray New Guinea swiftlets, I want to summarize again the differences between the two species *hirundinacea* and *vanikorensis* (see also Mayr and Rand, *loc. cit.*). *Collocalia hirundinacea* differs from *C. vanikorensis* by having the tarsus feathered, by having a smaller and more curved bill, by having much more white on the back (see footnote p. 4), by being smaller, by having the upper parts darker and more bluish, by having the crown decidedly darker than the back, by having lighter, more silvery gray under parts, by not having the throat contrasting with a much darker abdomen, by having under wing-coverts and feathers of the superciliary pure black not with pale edges, and by having a different ecology. *C. hirundinacea* is a bird of the hills and mountains right up to the highest peaks, but is rare in the lowlands; *C. vanikorensis* is common on the coast and in the lowlands, rare in the hills and has never been collected

above 1400 m. There is some variation in several of these characters, but the combination of these characters helps to identify almost every specimen. There are only two birds from the lowlands of southeast New Guinea in the collections of the American Museum which do not quite fit the above definition (see pp. 14-15).

Collocalia hirundinacea hirundinacea Stresemann

Collocalia fuciphaga hirundinacea STRESEMANN, 1914, Verh. Orn. Ges. Bayern, XII, p. 7.—"Utakwa" [= Setekwa] River, Dutch New Guinea.

Collocalia fuciphaga pseudovestita STRESEMANN, 1923, Arch. Naturgesch., LXXXIX, fasc. 8, p. 27.—Friedrich Wilhelms'hafen [= Madang], Astrolabe Bay.

Collocalia fuciphaga mayri HARTERT, 1930, Novit. Zool., XXXVI, p. 93.—Siwi, Arfak Mts.

A comparative description has been given p. 12, for further details on the various populations, see below, pp. 13-14.

Wing 114-117 (115.6), outermost tail-feather 48-53 (49.2), central tail-feather 41-45 (42.5), furcation 6-9 (7.4), tail-index 42.6.

RANGE.—All New Guinea, Dampier, and Goodenough Islands.

I doubt the validity of *pseudovestita*; when Stresemann described this form, part of his material belonged to *vanikorensis*, part of it consisted of old and foxed specimens. When Hartert described *mayri* on the basis of the heavy feathering of the tarsus, he compared the unique type with a series of "*hirundinacea*" which partly consisted of specimens of *vanikorensis* with bare tarsi. The only possible differences of *mayri* compared to *hirundinacea* are the paleness of the under parts and the practical absence of shaft-streaks on the abdomen. It is true, however, that lowland specimens of *hirundinacea* usually have less feathering on the tarsus than birds collected in the mountains.

Wear and foxing (the effects of these two factors have been described on p. 5) are the main reason why collections from the different parts of New Guinea in the A. M. N. H. Collection do not agree in all details of coloration. It might be valuable to describe these differences in detail, because the possibility exists that some of these differences are due to geographical variation.

SETEKWA RIVER, DUTCH NEW GUINEA (1910).¹—The typical series of three specimens (including the type) is now 27 years old and shows considerable evidence of foxing. The type is worn and molting (Jul 28), another August specimen has molted much of its body plumage but wings and tail are worn and old, a third specimen (Sept. 13), is fresh throughout. Foxing has given the under parts a somewhat brownish

¹ In parentheses, the year in which the specimens were collected.

appearance, as compared to the silvery gray of freshly collected birds. Streaking on lower belly is present, but inconspicuous; upper parts RATHER dark (for example as compared to a series from the Hydrographer Mts.) and even in fresh specimens rather bluish green. Tarsus feathering always present, but rather slight.

LOWER MENOO (300 m.) (1931).—1 ♂ ad. Quite dark above and below; streaking on lower belly very pronounced; feathering of tarsus slight; size of white loreal spot reduced.

SIWI-ARFAK (800 m.). (1928).—1 ♂ ad. (type of *mayri*). Very light underneath, but rather worn; near the end of its molt; streaks on belly almost absent; upper parts dark, white basal feathers reduced.

DAMPIER IS. (1914).—1 ♀ ad. Rather brownish underneath; shaft-streaks on belly fairly conspicuous; tarsal feathering slight; upper parts rather dark; white feathering on back very pronounced; white loreal spot medium.

ZAKAHEME (HUON PENINSULA) (1929).—Six specimens. Rather light and silvery underneath; shaft-streaks on lower belly inconspicuous; feathering on tarsus apparently originally quite strong, though largely lost in most specimens due to poor preservation; white loreal spot rather large; upper parts lighter and more greenish than in typical series; white feathering on back rather strongly developed.

HYDROGRAPHER MTS. (1918).—Three specimens. Rather light and silvery underneath, but shaft-streaks well developed; tarsi strongly feathered; white loreal spots large; upper parts similar to Zakaheme series, though not quite as greenish; white feathering on back medium.

GOODENOUGH IS. (1896).—One specimen. 40 years old and rather foxed. Originally apparently rather dark above and rather bluish green; tarsi fairly well feathered; underneath now rather brownish, although without shaft-streaks; supraloral spots large; white feathering on back medium.

MURRAY PASS 2840 m (1933).—Three ♂ ad. Rather greenish above and not quite as dark as typical birds; underneath grayish, a little darker than Zakaheme birds, shaft-streaks on belly present, but not very conspicuous; tarsi strongly feathered, supraloral spots medium; white feathering on back very pronounced.

Specimens from Ononge, Mt. Albert Edward and Mt. Tafa are similar.

Here follows the description of two unusual specimens:

KUBUNA (100 m.) (1933).—1 ♂. Above greenish and a shade darker than the mountain birds; underneath distinctly darker than the

Zakaheme series, particularly on belly, with shaft-streaks very inconspicuous; tarsi halfway feathered; under tail-coverts rather dark; loreal spot small; WHITE FEATHERING ON BACK ABSENT; crown not darker than back, but rump (apparently belonging to earlier plumage) definitely lighter; tail very slightly furcated.

Wing 113, tail 41/45 (4), index 39.8; very short tail.

BAROKA (sea-level) (1933).—1 ♂. Above quite dark, much darker than mountain birds and rather bluish green; crown darker than back; underneath fairly light, with just a shade of brownish, under tail-coverts fairly dark; shaft-streaks present, but not strongly developed; TARSIS PRACTICALLY BARE; loreal spot large; white feathering on back VERY pronounced.

Wing 110, tail 39.5/47, (7.5), index 42.7.

More material from the lowlands of southeast New Guinea is needed to determine the taxonomic status of these two specimens.

Collocalia hirundinacea excelsa Ogilvie-Grant

Collocalia hirundinacea excelsa Ogilvie-Grant, 1914, Bull. Brit. Orn. Club, XXXV, p. 34.—Utakwa River, 8000 feet. [Not seen.]

According to the original description in coloration like *hirundinacea*, but very much larger.

Male, wing 127, tail 58, tail-index 44.1; female, wing 131, tail 63, tail-index 48.1. (This would indicate an exceptionally long tail, but I doubt the correctness of Ogilvie-Grant's measurement.)

RANGE.—Only known from the type-locality, but probably throughout the higher altitudes of the Snow Mts.

It is interesting that the birds collected by the Archbold 1933 Expedition on Mt. Albert Edward (3700 m.) and Murray Pass (2800 m.) are not much larger than lowland *hirundinacea*. Most of these specimens are unfortunately molting their longest wing-feathers, but a series of tail-measurements (outermost feathers) is as follows: 49.5, 50, 51, 51, 51, 52, 53, 53, 56 (51.8). This averages larger than a series of lowland birds (48–53 (49.2)), but the difference is not sufficient for subspecific separation.

Collocalia hirundinacea baru Stresemann and Paludan

C. vanikorensis baru STRESEMANN AND PALUDAN, 1932, Novit. Zool., XXXVIII, p. 167.—Kampong Baru, Japan Island.

Similar to *hirundinacea*, but averaging smaller; under parts slightly and upper parts very much darker and more bluish; shaft-streaks on abdomen pronounced; supraloral spots large; much white on back; tarsi fairly well feathered, at least in upper part.

Wing (6) 109-114.5 (111.2), central tail-feather 40-41, outer tail-feather 46-48 (47.8), furcation 6-8 (7.4), tail-index 43.0.

RANGE.—Only known from the type-locality.

Collocalia spodiopygia

Under this name I combine a number of forms with whitish rumps which occur east of the Wallace line, except on New Guinea, and the Papuan Islands. Stresemann (1932, Novit. Zool., XXXVIII, pp. 164-170) distributes these forms in two species; the eastern ones (Polynesia and Melanesia) he includes in *spodiopygia*, the western ones (North Australia, Moluccas, Celebes) he includes in *vanikorensis*. He does not mention any morphological characters by which these two groups can be distinguished, in fact he says of *ceramensis* (which he includes with *vanikorensis*) "apparently not distinguishable" from *leucopygia* (which belongs to *spodiopygia*).

I propose to include the western forms and the eastern forms in one species, because I am unable to find any morphological characters by which they could be separated. They all agree in having a well-pronounced whitish rump-band, not merely a paling of the lower back as most of the *germani* forms. The black rumped *hirundinacea* is obviously a geographical representative of *spodiopygia*. Both species agree in most of their essential morphological features and their ranges do not overlap anywhere. Stresemann (*loc. cit.*, p. 165, 169) described a series of *C. infuscata* from the northern Moluccas in which some specimens have the white rump, others lack it. I have recently been able to examine this series of *infuscata*, owing to the kindness of Dr. Stresemann, and it has fully confirmed my previous conclusions. *C. sp. infuscata* is a darkened form of the *spodiopygia* group, not very different from *sororum*. The rump-band is dark gray, not pale gray as in most *spodiopygia* forms, and is practically absent in one specimen. This latter bird is very similar to *Collocalia hirundinacea baru* Stres. and Pal. The fact that the rump-band is variable shows clearly that the relationship between *spodiopygia* and *hirundinacea* is still closer than was hitherto apparent.

A detailed revision of the species *spodiopygia* is in preparation. I shall content myself at the present time to list all the described forms which I propose to include in this species: *spodiopygia* (Samoa), *townsendi* (Tonga), *assimilis* (Fiji), *leucopygia* (New Caledonia), *reichenowii* (Solomon Islands), *eichhorni* (Bismarck Archipelago), *terraereginae* (North Queensland), *ceramensis* (southern Moluccas), *infuscata* (northern Moluccas), and *sororum* (Celebes).

Collocalia leucophaea, *vanikorensis* + *inquireta*, and *spodiopygia* + *hirundinacea* are the species of gray *Collocalia* that are endemic east of the Wallace line. Some forms of western species (*macans*, *bartschi*, and *pelewensis*) have entered the Australian Region near its western border. I have seen only very little material from west of the Wallace line and have examined only a few types. Although this makes it impossible for me to undertake a revision of all the forms, I would like to record a few of the preliminary results of my studies.

Collocalia "mearnsi"

This comprises forms usually grouped with *vestita* (Sumatra). Not having seen any material from Sumatra, I choose temporarily the safer name "*mcarnsi*." Distinguished by the following characters: rump dark and glossy as back; tarsus feathered; size small; upper parts dark, more blackish, with a pronounced bluish-green gloss; crown dark bluish green, quite distinct from the paler and more greenish back; crown covered by many, but small feathers; under wing-coverts uniformly dark; feathers of throat very soft; bill strongly curved; tail medium long, but little furcated; much white on back.

RANGE.—Philippines, Borneo, and Maratua.

This species is closely related to *hirundinacea* and *spodiopygia*.

Collocalia germani

Under this name I group several forms usually called *francica*. I have not seen any specimens of *francica*, but it seems altogether unlikely in this genus of strongly localized species, that a species from Mauritius should be conspecific with one occurring in Malaysia.

It is principally this species which makes the edible nests. It is distantly related to *Collocalia vanikorensis*. Its chief characters are: rump frequently paler than back; upper parts rather pale with a brownish-green gloss; crown greenish, only slightly darker than back; crown covered by few, but larger feathers; much white on back; under wing-coverts usually with broad pale edges; size large, tail short, but fairly well furcated; tarsus bare or slightly feathered, particularly in highland populations; bill fairly large and only weakly curved; feathers of throat often with shaft-streaks. As always with these species descriptions, not all of the above given characteristics apply necessarily to every individual, but the combination of these characters will serve to separate these birds from similar species. I have seen much too little material to say anything about the geographical variation within this spe-

cies, but it seems that the following races belong to *germani*: *macans* (Timor, etc.), *dammermani* (Flores), *javensis* (Java, if different from *dammermani* and *perplexa*), *perplexa* (Maratua), *bartelsi* (??) (Java), *amelis* (Philippines), *pelewensis* (Palau), *bartschi* (Marianne Is.), *amechana* (Anamba Is., not seen!), and *germani* (coast of Borneo, Malay Peninsula north to Indo-China).

Collocalia fuciphaga

This name has been restricted by Stresemann to the large highland species of Java (1914, Verh. Ornith. Ges. Bayern, XII, p. 3).

It is characterized by large size (118-122), bare tarsus and a big bill. The rump is as dark as the back, the upper parts are rather dark with a greenish gloss, the crown is only slightly darker than the back. ~~THERE IS NO WHITE ON THE BACK~~ (see footnote, p. 4). The tail is long (tail-index 45.7) and fairly well furcated 6-9 (8.1).

This species has never been found outside of Java, but there is on the Natuna Islands and on north Borneo a population, which is amazingly similar to it, except that it has a very short tail (index 38.2) which is hardly at all furcated (3-4, 3.3). This species, also characterized by the absence of white on the back, has been named *natunae* by Stresemann (1930, Ornith. Monatsber., XXXVIII, p. 181). The recently learned fact, that short-tailed and long-tailed populations may occur in one species (*leucophaea*, *vanikorensis*), makes it possible to think of a relationship of these two species. It is quite certain, however, that *natunae* has nothing to do with *mearnsi*. The possible relationship of *natunae* with *lowi* and several mainland forms requires further investigation.

I have seen too little material to say anything about *lowi*, *inceperata*, *innominata*, *brevirostris*, *unicolor*, *aerophila*, *vestita*, *elaphra*, and *francica*. Several of these are probably good species.

Excluding the Asiatic forms, also the species *esculenta*, *troglodytes*, *lowi*, *whiteheadi*, and *gigas*, as well as the forms *vestita*, *bartelsi*, and *vulcanorum*, which are unknown to me, I find the following distribution of the above discussed forms. The nine specific groups, admitted by me, may have to be reduced after further investigation. *C. spodiopygia*, *hirundinacea*, and *mearnsi* are related and possibly conspecific, the same is true for *vanikorensis* and *inquieta*, and for *fuciphaga* and *natunae*.

EASTERN POLYNESIA.—1) *leucophaea* (+ *ocista*)

CENTRAL POLYNESIA.—2) *spodiopygia* (+ *townsendi* + *assimilis*)

SOUTHERN MELANESIA.—2) *spodiopygia* (*leucopygia*); 3) *vanikorensis*

NORTHERN MELANESIA.—2) *spodiopygia (reichenowi + eichhorni)*;
3) *vanikorensis (+ lhirensis + coultasi)*

NEW GUINEA REGION.—3) *vanikorensis (granti + tagulae + steini + waigeuensis)*; 4) *hirundinacea (+ excelsa + baru)*

CAPE YORK.—2) *spodiopygia (terraereginae)*; 3) *vanikorensis (yorki)*

MOLUCCAS.—2) *spodiopygia (ceramensis + infuscata)*; 3) *vanikorensis (moluccarum)*

CELEBES REGION.—2) *spodiopygia (sororum)*; 3) *vanikorensis (aenigma + heinrichi)*

CAROLINES.—5) *inquieta (+ rukensis + ponapensis)*

WESTERN MICRONESIA.—6) *germani (bartschi + pelcwensis)*

LESSER SUNDA ISLANDS.—6) *germani (micans + dammermani)*

JAVA.—6) *germani (javensis)*; 8) *fuciphaga*

BORNEO.—6) *germani (+ perplexa)*; 7) *mearnsi (+ maratua)*; 9) *natunae*

PHILIPPINES.—6) *germani (+ amelis)*; 7) *mearnsi*

AMERICAN MUSEUM NOVITATES

Number 916

Published by
THE AMERICAN MUSEUM OF NATURAL HISTORY
New York City

April 17, 1937

TWO NEW BATS, *EPTESICUS* AND *MOPS*, FROM ANGOLA

BY JOHN ERIC HILL

In the collection of mammals from Angola, secured by the Vernay Angola and Phipps-Bradley Expeditions, are two bats apparently new to science.

Acknowledgments and thanks are due to Dr. H. E. Anthony, Curator of Mammals, The American Museum of Natural History, for helpful criticism, and to Dr. A. Avinoff, Director of the Carnegie Museum, and Mr. J. Kenneth Doult, Curator of Mammals there, for the loan of pertinent specimens.

Measurements are expressed in millimeters and color terms are those of Ridgway.¹ The text-figure is the work of Miss Helen Z. Hunt.

Eptesicus capensis angolensis, new subspecies

TYPE.—No. 85535, Amer. Mus. Nat. Hist.; ♂ adult, skin and skull; from Chitau, Angola. Secured by the Vernay Angola Expedition, Mr. H. Lang, collector, orig. no. 620, August 5, 1925.

The American Museum has a series of 18 from the type locality; there are two skulls, also topotypical, in the Carnegie Museum, Pittsburgh. Records of *E. capensis* in Angola, possibly referring to this race are Caconda and Huilla²; Vila da Ponte.³ The more southern records may possibly concern *E. c. nkatiensis* Roberts.

GENERAL CHARACTERS.—A race of *Eptesicus capensis* with blackish wings and yellowish-brown body, the hairs above and below without dark bases.

COLORATION.—Upperparts darker than tawny olive, the bases of the hairs paler. Underparts slightly grayer than cinnamon-buff. Wing membranes and ears blackish, uropatagium slightly paler.

SKULL.—Braincase considerably higher than rostrum; the latter broad and short. Occipital height more than 65 per cent of mastoid breadth in adults.

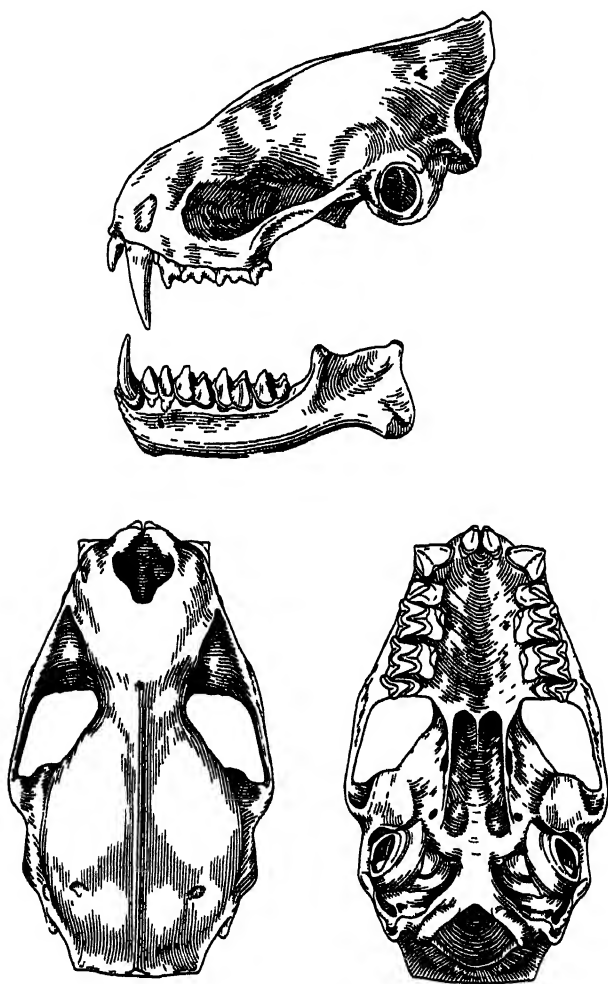
DENTITION.—Medial upper incisor (I²) deeply bifid; I³ with small posterior cusp, only about one-third shorter than I². I₁₋₃ placed in line with the margin of lower jaw. Other teeth about as in *E. minutus*.

¹ 1912, 'Color standards and nomenclature.'

² 1900, Seabra, Jorn. Sci. Math. Phys. Nat., Lisbon, (2) VI, p. 22.

³ 1933 (1932), Monard, Bull. Soc. Neuchatel. Sci. Nat., LVII, pp. 49.

MEASUREMENTS.—Head and body, 56; tail, 34; hind foot, 10; ear, 12.5; forearm, 37.0; digit III, $34.1 \times 12.9 \times 12.0 \times 6.8$. Skull: greatest length, 14.2; basilar length, 11.6; palatilar length, 5.9; zygomatic breadth, 10.4 (approximate); interorbital breadth, 4.2; mastoid breadth, 8.5; outside breadth across $M^2 - M^2$, 6.9; height occiput, 5.8; maxillary alveoli, 5.4; crowns $P^1 - M^2$, 4.3; width M^1 , 1.5.



A M 88116

Fig. 1. Lateral, dorsal, and ventral views of skull, *Mops chitauensis*, n. sp. $\times 5/2$.

***Mops chitauensis*, new species**

TYPE.—No. 88116, Amer. Mus. Nat. Hist.; ♂ adult, skin and skull; from Chitau, Angola, alt., 4930 ft. Secured by the Phipps-Bradley Expedition, Mr. Lee S. Bradley, collector, orig. no. 676, February 10, 1933.

This species is known only from the type specimen.

GENERAL CHARACTERS.—A blackish brown, grizzled species of *Mops*; skull with high lambdoidal crest. Uropatagium reaches to heel, wing membrane attached to lower third of tibia.

COLORATION.—Upperparts near fuscous-black, shading into black on the head, grizzled with whitish hairs and tips; bases of hairs paler. Underparts dirty whitish. Wings darker than fuscous, as are the ears. Upper arms and legs pale.

SKULL.—Short and broad; supraoccipital region produced more than usual for *Mops*, but sagittal crest poorly developed.

DENTITION.—Upper incisors closely approximated, separated from canines by a gap. P^3 minute, situated laterally to axis of tooth row; P^4 and canine in contact medially. M^3 about half size of M^1 and M^2 , with a V-pattern.

MEASUREMENTS.—Head and body, 75; tail, 41; forearm, 46.3; digit III, $47.0 \times 19.4 \times 19.9 \times 8.4$. Skull: greatest length, 23.3; basilar length, 17.6; palatilar length, 8.2; zygomatic breadth, 14.5; interorbital breadth, 4.5; mastoid breadth, 12.7; outside breadth across $M^2 - M^2$, 9.7; maxillary alveoli, 9.1; crowns $P^4 - M^3$, 7.0; width M^1 , 2.9.

Except for coloration, this species resembles the description of *Mops angolensis* (Peters). A specimen from Chitau, agreeing in color with Peters' description,¹ collected by the Pulitzer Angola Expedition of the Carnegie Museum, has less extensive uropatagium and the wing membranes attach to the middle of the tibia. Cranially the occipital region is much less produced.

¹ 1870, Journ. Sci. Math. Phys. Nat., Lisbon, (1) III, p. 124.

AMERICAN MUSEUM NOVITATES

Number 917

Published by
THE AMERICAN MUSEUM OF NATURAL HISTORY
New York City

April 30, 1937

STUDIES OF PERUVIAN BIRDS. NO. XXV¹

NOTES ON THE GENERA *THAMNOPHILUS*, *THAMNOCHARIS*, *GYMNOPITHYS*, AND *RAMPHOCAENUS*

By JOHN T. ZIMMER

Receipt of additional material has made it possible to discuss a number of species which were left in abeyance when their immediate allies were discussed in former numbers of this series. It has also made it desirable to revise the treatment of *Ramphocaenus melanurus* which now appears to be divisible into several additional forms not recognized heretofore.

As in previous papers, names of colors are capitalized when direct comparison has been made with Ridgway's 'Color Standards and Color Nomenclature.'

I am greatly indebted to Dr. C. E. Hellmayr for certain notes on European material which have been helpful in these studies, and to Dr. J. Domaniewski for the loan of a critical specimen.

Thamnophilus praecox, new species

TYPE from the mouth of Lagarto Cocha, eastern Ecuador. No. 255,955, American Museum of Natural History. Adult female collected January 26, 1926, by Carlos Olalla and sons.

DIAGNOSIS.—Female coloration not very similar to that of any other member of the genus *Thamnophilus* but very like that of females of *Myrmeciza melanocephala* from which it differs as follows. Anterior parts of head very finely streaked with whitish; cinnamonaceous color of lower breast and belly somewhat more ochraceous and less pinkish; inner margins of remiges with basal portion marked by rather broad, sharply defined pinkish cinnamon; tail and wings somewhat lighter rufous; size smaller; space before and behind eye fully feathered and other characters of *Thamnophilus*, as distinguished from *Myrmeciza*, equally in evidence.

RANGE.—Known only from the type locality.

DESCRIPTION OF TYPE.—Top and sides of head and neck, chin, throat, and upper breast black, forming a complete black hood sharply defined from the rest of the plumage; forehead, anterior part of crown, lores, malar region, base of auriculars, chin, and upper part of the throat with whitish shafts; back Sanford's Brown × Burnt Sienna, with subterminal portion of the feathers of the mantle paler; lower breast Mars Yellow × Ochraceous-Tawny, passing into Amber Brown × Sanford's

¹ Earlier papers in this series comprise American Museum Novitates, Nos. 500, 509, 523, 524, 538, 545, 558, 584, 646, 647, 668, 703, 728, 753, 756, 757, 785, 819, 860, 861, 862, 889, 893, and 894.

Brown on the under tail-coverts. Tail Auburn; wings blackish, with outer webs of remiges and the exposed portions of the upper coverts light Auburn; basal portion of inner margins of remiges occupied by a sharply defined stripe of Pinkish Cinnamon \times Vinaceous-Cinnamon. Bill (in dried skin) blackish, with a slaty tinge on the mandible; feet black. Wing, 74.75 mm.; tail, 59; exposed culmen, 17; culmen from base, 22; tarsus, 23.25.

REMARKS.—Male unknown.

There is only one species in the genus *Thamnophilus* to which any relationship is even suggested. This is *T. nigriceps* of eastern Panamá and Colombia, which has no known representative in Ecuador. From *T. n. magdalenae* of the Magdalena Valley of Colombia, the present bird is distinguishable, in the female plumage, by the much greater reduction in the streaking of the head and anterior under parts and the greater intensity of the rufescence on the remainder of the plumage. The pattern on the inner margins of the remiges, the shape of the bill, and the general proportions of the two forms are very similar. Possibly *praecox* will some day be found to be a representative of *nigriceps*, but with the male unknown it would be undesirable to do more at the present time than suggest the possibility of such relationship.

If this relationship should materialize, it may be found that the male will be nearly all black, with white markings on the under wing-coverts and on the inner margins of the remiges, much as in the males of the known forms of *nigriceps*. It is suggested, therefore, that there may be existing specimens that have been confused with males of *Thamnophilus aethiops* which inhabits the same region and which has some of the characteristics here indicated.

Although not found in Perú up to date, the type locality of *praecox* is so close to Peruvian territory that the range may be found to cross the border when more material is available. Hence I have included the description in this series of papers on Peruvian birds and their affines.

SPECIMENS EXAMINED

T. praecox.—ECUADOR: mouth of Lagarto Cocha, 1 ♀ (type).

Thamnocharis dignissima (Sclater and Salvin)

Grallaria dignissima SCLATER AND SALVIN, 1880, P. Z. S. London, p. 160, Pl. XVII.—Sarayacu, eastern Ecuador; cotypes in British Mus.

I have a male from the mouth of the Río Santiago and a female from the Río Mazán, in Peruvian territory, presented by Dr. Harvey Bassler. These are the first specimens obtained in Perú, although

the eventual discovery of the bird in this country was, perhaps, to be expected after it was found on the lower Napo in Ecuador.

A male from the mouth of Lagarto Cocha and a female from the mouth of the Río Curaray, eastern Ecuador, compare well with the Peruvian birds. There is apparent a slight sexual difference which may be recorded here. The males have the dark margins of the elongated femoral feathers quite blackish, the throat and breast ochraceous brown, and the back about as olivaceous as the top of the head. The females have the femoral margins more brownish, the pectoral region deeper and more rufescent, and the back distinctly warmer than the crown.

SPECIMENS EXAMINED

T. dignissima.—ECUADOR: mouth of Lagarto Cocha, 1 ♂; mouth of Río Curaray, 1 ♀. PERÚ: mouth of Río Santiago, 1 ♂; Río Mazán, 1 ♀.

Gymnopithys leucaspis peruana, new subspecies

TYPE from Chamicuros, Peru. No. 450,934, American Museum of Natural History (Rothschild coll.). Adult male collected August 19, 1867, by Edward Bartlett; original no. 2664.

DIAGNOSIS.—Nearest to *G. l. leucaspis* of the Bogotá region, eastern Colombia, but dorsal coloration paler, especially on the top of the head.

RANGE.—Northern Perú on the south bank of the Marañón.

DESCRIPTION OF TYPE.—Top of head deep Sanford's Brown (\times light Chestnut), distinctly brighter than the mantle which is brownish Auburn; rump a little duller; under tail-coverts a little brighter. Lores with lower portion dull rufescent with blackish tips; upper portion with whitish bases and stronger black tips, forming a black line which is carried over the orbit to connect with the black postocular space; malar region and anterior part of auriculars, back to beyond the posterior border of the orbit, white; chin, throat, middle of breast, and middle of belly broadly white; sides of neck, sides of breast, and anterior flanks black, forming a broad lateral border to the white median parts; femoral tufts Cinnamon-Brown; thighs a little brighter; under tail-coverts with distal half of the feathers Cinnamon-Brown tipped more or less broadly with dull whitish. Exposed portion of outer surface of the wings a little brighter than the back; bend of wing on under side whitish; remainder of under wing-coverts grayish. Tail like the mantle, brighter on the outer margins of the feathers. Maxilla (in dried skin) black; mandible yellowish white, with extreme base blackish; feet faded, nearly colorless. Wing, 78 mm.; tail, 49; exposed culmen, 17; culmen from base, 19.75; tarsus, 25.5.

REMARKS.—Female unknown.

Three additional males from the same general region agree rather exactly with the type. A fifth male is somewhat more deeply colored above, approaching the palest of the birds from eastern Ecuador although remaining closer to the other specimens of *peruana*. This specimen, furthermore, shows somewhat more black on the auriculars,

also an approach toward *castanea*, although most of the feathers of the black superciliary stripe have whitish bases.

An additional record from Tarapoto presumably belongs here.

***Gymnopathys leucaspis castanea*, new subspecies**

TYPE from Río Suno, eastern Ecuador. No. 184,498, American Museum of Natural History. Adult male collected April 14, 1923, by Carlos Olalla and sons.

DIAGNOSIS.—Similar to *G. l. leucaspis* of the Bogotá region of eastern Colombia, but much darker and more intensely colored above, and with the top of the head much less differentiated from the mantle; flanks averaging darker brown and the amount of black on the sides of the breast usually distinctly greater; lores more decidedly blackish, without prominent whitish bases on upper portion.

RANGE.—Eastern Ecuador.

DESCRIPTION OF TYPE.—Back Chestnut × Bay with obscure traces of broad black shaft-stripes; rump approaching Auburn; upper tail-coverts brighter, near Mahogany Red; tail Bay, with outer margins brighter; top of head deep Chestnut, forehead a little lighter than crown; lores, a narrow superciliary line, and a broad postocular band black, involving the sides of the neck and the posterior part of the auriculars; subocular space, including anterior part of auriculars and the whole malar region, white with fine, blackish, hair-like tips which give a dusky appearance to the area, intermediate between the white cheeks of *leucaspis* and the black ones of the “*bicolor* group”; the black of the sides of the neck continued down the sides of the breast and the upper flanks in a broad lateral border, posteriorly becoming broader and browner and changing to very dark Argus Brown × Brussels Brown; thighs deep Argus Brown; chin, throat, breast, and middle of abdomen white, with some traces of dusky tips on feathers of breast; under tail-coverts blackish brown with broad tips Tawny Olive; wings blackish with outer margins and other exposed portions the color of the back; under wing-coverts grayish, with traces of white toward outer margin of wing. Maxilla black (in dried skin); mandible black at base, whitish medially, and dusky terminally; feet dull slaty gray. Wing, 74.5 mm.; tail, 43.5; exposed culmen, 16; culmen from base, 20.25; tarsus, 26.

REMARKS.—A bird labeled female is similar to the type but has the mantle feathers a little paler gray at base, one or two of them having a suggestion of a pale (whitish) spot sub-basally; outermost black feathers on sides of breast with inconspicuous rufous brown tips; general color a little paler than the type but much darker than *leucaspis*. If properly sexed, the absence of the broad ochraceous patch (concealed on the mantle in female *leucaspis*) is diagnostic, but with only a single specimen, differing so slightly from the males but diverging more pronouncedly from the females of the other forms, there is suspicion of an error in sexing.

On the other hand, females of the allied “*bicolor* group” do not have a concealed patch of buff on the mantle and it is quite possible that *castanea* may prove to be similar in this particular. It approaches

the "bicolor group" closer than the other forms of *leucaspis* in respect to the somewhat more extensive black on the auriculars. The form *aequatorialis* sometimes has an indication of a trend toward the same common ground shown by a slight encroachment of white on the lower or anterior malar region, and the development of black along the sides of the lower under parts is often equal to that in *peruana*. Some examples of *olivascens* have the same sort of lores possessed by *leucaspis*, with more or less white on the lower part surmounted by a black upper border. The presence of a bright (concealed) interscapular patch in the females of *leucaspis* and *lateralis*, which is totally lacking in the "bicolor group," appears to be the most decisive difference, but, since this feature is variable in some other species of the *Formicariidae*, I doubt its specific value. Consequently, I consider *bicolor* and its affines as belonging to the *leucaspis* group of which they are strict geographic representatives.

Gymnopathys leucaspis lateralis Todd

Gymnopathys leucaspis lateralis Todd, 1927 (Dec. 2), Proc. Biol. Soc. Wash., XL, p. 174—Manacapurú, Brazil; ♂; Carnegie Mus.

Thirteen specimens from the region of the upper Rio Negro, Brazil, differ from seven Bogotá skins, representing typical *leucaspis*, by their somewhat browner dorsal surface and by having the under tail-coverts averaging paler, sometimes almost as immaculate white as the lower belly. Some examples are not clearly distinguishable in this latter respect from extremes of typical *leucaspis*, but these are exceptions. The under wing-coverts also show a more extensive white area. The blackish stripe on the sides of the under parts reaches well posteriad, often to the base of the thighs, but is equally extensive in most Bogotá skins. The white area on the auriculars is somewhat more extensive and often reaches posteriad past the posterior line of the orbit. The femoral area is sometimes more brownish than in Bogotá specimens, but some examples are well matched.

Most of these characters have been given as distinguishing features of *lateralis* and, although there appears to be a trend in the direction of typical *leucaspis*, the upper Rio Negro specimens presumably should be referred to the Manacapurú form.

SPECIMENS EXAMINED

G. l. leucaspis.—COLOMBIA: "Bogotá," 3 [♂?], 4 [♀].

G. l. castanea.—ECUADOR: upper Río Suno, 1 ♂ (type); mouth of Río Curaray, 2 ♂, 1 ♀.

G. l. peruana.—PERÚ: Chamicuros, 3 ♂ (incl. type); Jeberos, 1 ♂; Chayavitas, 1 ♂.

G. l. lateralis.—BRAZIL: Rio Negro, Tatú, 3 ♂, 5 ♀; Mt. Curycuryari, 1 ♂; Yucabi, 1 ♀; Rio Uaupés, Tahuapunto, 1 ♂; Iauarate, 1 ♂, 1 ♀.

G. l. aequatorialis.—WESTERN ECUADOR: 14. Southwestern COLOMBIA: 7.

G. l. daguae.—WESTERN COLOMBIA: 8 (incl. type).

G. l. ruficeps.—COLOMBIA: "Bogotá," 2; Antioquia, 1.

G. l. bicolor.—COLOMBIA: Alto Bonito, 1. Eastern PANAMÁ: 24.

G. l. olivascens.—WESTERN PANAMA: 43. COSTA RICA: 17. NICARAGUA: 13.

Gymnopathys salvini maculata, new subspecies

TYPE from Lagarto, upper Río Ucayali, eastern Perú. No. 239,152, American Museum of Natural History. Adult female collected March 17, 1928, by Carlos Olalla and sons.

DIAGNOSIS.—Males indistinguishable from those of *G. s. salvini* of northern Bolivia and the Rio Madeira Valley of Brazil, but females more heavily marked on the back and upper wing-coverts.

RANGE.—Ucayali Valley, eastern Perú, extending eastward along the south bank of the Amazon into western Brazil as far as Tefé.

DESCRIPTION OF TYPE.—Top of head with shafts and tips of feathers black, overlying the dull rufous lateral and basal portions of the feathers; the nape near Argus Brown, passing into Argus Brown × Brussels Brown on the mantle where, however, each feather is broadly tipped with bright Sanford's Brown × Burnt Sienna, with an equally broad subterminal bar of black; the extreme upper margin of the mantle with these marks obsolete; scapulars like the mantle; center of mantle with a concealed patch of pinkish cinnamon; uropygium darker and with the markings less prominent; upper tail-coverts light rufous with several dusky bars. Loes, superciliary region, sides of head and neck, chin, and throat dark Sanford's Brown × Burnt Sienna, passing into Sanford's Brown on the breast; middle of belly paler, Cinnamon-Rufous; flanks suffused with dark Dresden Brown; under tail-coverts Cinnamon-Rufous. Tail bright Auburn crossed by eight narrow black bars, of which those on the basal portion of the feathers are not continuous across the shaft but alternately spaced; the distal ones are continuous, the last one subterminal. Remiges fuscous with outer margins light Auburn, tending toward ochraceous on the two outer feathers; tips light cinnamonaceous (obsolete on the outer few feathers) preceded by a dusky line; tertials with ground color dark Hazel with a brighter rufous tip and blackish subterminal bar which turns basad on the outer web; an antepenultimate spot of pale cinnamon is present on the tertials and suggested on the inner secondary. Upper wing-coverts with sharply defined borders of Ferruginous × Burnt Sienna and with the rest of the feather blackish, with a deeper tone of black subterminally, forming a black subapical bar on a few of the inner feathers of the greater and median series; bend of wing light Sanford's Brown; rest of wing-lining like the flanks. Maxilla (in dried skin) blackish; mandible yellowish; feet brown. Wing, 75 mm.; tail, 46; exposed culmen, 15; culmen from base, 20; tarsus, 25.5.

REMARKS.—Males gray with white upper border of the loes carried narrowly and indistinctly over the eye; remainder of loes blackish; chin, throat, malar region, and anterior portion of auriculars white,

forming a large gular patch; tail blackish with gray outer margins and with about eight narrow white cross-bars, the last one terminal and crossing both webs, the remainder variable, usually absent from the outer web of the median pair and often only on the inner web of the outer pair, rarely absent from both webs of the median pair; tips of the secondaries narrowly white preceded by an indistinct dusky area; greater upper wing-coverts rarely marked in a similar manner; bill and feet black. Size about equal to the females.

The female of this form was described by Hellmayr (1907, Novit. Zool., XIV, p. 72) as the female of typical *salvini*, and the females of the typical form were characterized later (*t. c.*, p. 385) in the belief that only a single form existed. This belief was occasioned by the extreme similarity of certain examples from different parts of the specific range. These same examples are now before me, together with much more material from still other parts of the specific range, and such a large proportion of the females fall readily into two definite series that it seems advisable to recognize two subspecies instead of a single form. Thus, one of five females from Humaythá, Rio Madeira, has the mantle plainly marked with blackish subterminal bars and bright rufescent tips, but the black bars are narrower than those in *maculata*; furthermore, the upper wing-coverts are not so blackish in their centers, although they are a little darker than in most other typical *salvini*. One of eight females from Rosarinho is like the mentioned female from Humaythá while a second Rosarinho bird, not quite adult, is a little more strongly marked though it is much paler in general coloration than any adults. A female from Todos Santos, Bolivia (nearly topotypical of *salvini*) has small blackish markings on the lower mantle and scapulars, but the upper wing-coverts have less contrast than usual between the centers and the margins. The other birds from Rosarinho and Humaythá have only slight suggestions of pale tips and darker brown subterminal marks. On the other hand, four adult females from Teffé, Brazil, and three from the Ucayali, Perú, are all boldly marked on the back, and even a fifth female from Teffé in juvenal plumage has a few feathers with similar markings on the lower part of the mantle and shows the same blackish centers on the upper wing-coverts.

The young female has the top of the head Prout's Brown with faint indications of blackish bars at the tips and across the middle of the feathers; the back is lighter, near Cinnamon Brown, with similar obsolete traces of dark bars except where new feathers show the strong barring of the adult plumage; the uropygium is dark Dresden Brown. The

upper part of the lores is Cinnamon-Rufous and there is a very faint trace of the same color over the eye; the lower part of the lores is dusky and there is a dusky patch in the center of the auriculars and through the malar region; the rest of the sides of the head, the chin, and the throat are Cinnamon-Rufous \times Orange-Rufous, forming a bright patch corresponding to the white throat-patch of the adult males; the breast and sides are Bister, with slight blackish tips, forming a broad pectoral band; belly dull Light Brownish Olive where the brighter adult feathering has not appeared; under tail-coverts more cinnamomeous. Tail as in the adult female; wings like those of the adult female but duller. Bill (in dried skin) black; feet dull brownish.

The young male is much like the young female above but rather darker and without traces of dusky barring, except at the tips of the feathers on the top of the head. Lores dusky; sides of head, chin, and throat Fuscous, except where the gray or white feathering of the adult has appeared; breast crossed by a band of brighter brown, near Sepia; belly about like the throat or perhaps a little grayer although in all the young males at hand this region appears to have molted already into the adult gray, with only a few feathers of juvenal age remaining. Remiges fuscous, with exposed edges very dark brown; secondaries with small white spots at the tip; tertials with broader buffy or white tips preceded by a black bar; upper wing-coverts sooty brown with pale cinnamomeous tips and black subapical bars; tail blackish, banded with white as in the adult male but with the outer margins of the feathers brownish instead of gray.

Description of the juvenal plumage of both sexes is important in consideration of the affinities of *Gymnopathys lunulata*, the status of which is discussed below.

There are no previous records of *G. salvini* from Perú.

SPECIMENS EXAMINED

G. s. salvini.—BOLIVIA: Todos Santos, 2 ♂, 1 ♀; Mission San Antonio, Río Chimoré, 1 ♂. BRAZIL: Rio Madeira, Humaythá, 5 ♂, 5 ♀; Rosarinho, 14 ♂, 8 ♀; Santo Antonio de Guajará, 1 ♂.

G. s. maculata.—PERÚ: Lagarto, 1 ♂, 2 ♀ (incl. type); Santa Rosa, 1 ♂, 1 ♀; Sarayacu, 3 ♂; Orosa, 1 ♂. BRAZIL: Teffé, 7 ♂, 5 ♀.

Gymnopathys lunulata (Sclater and Salvín)

Pithys lunulata SCLATER AND SALVIN, 1873, P. Z. S. London, p. 276., Pl. xxvi—Sarayacu, Río Ucayali, Perú; ♀; British Mus.

A single female of this most interesting bird was secured by the

Olallas at Lagarto, upper Río Ucayali. I have seen, in addition, the specimen collected by Stolzmann at Yurimaguas, generously loaned by Dr. Domaniewski of the Warsaw Museum, and Dr. Hellmayr has kindly favored me with his manuscript notes on the type in the British Museum. Both of these other specimens also are females.

There is a strong suggestion of *G. salvini* in the general appearance of this bird, although the differences from it are equally striking; in fact, Berlepsch, when describing *salvini*, suggested the possibility that it might be the male sex of *lunulata* since he had no females of *salvini* at that time. With adults and young of both sexes of *salvini salvini* and *salvini maculata* at hand, it is impossible to fit *lunulata* anywhere into the picture, and yet there is an underlying impression that there is some connection yet to be established. In general, it may be said that *lunulata* combines certain features of the adults and young of both sexes of *salvini maculata* with certain peculiarities or modifications not found in them.

The facial markings are those of adult male *salvini* or *maculata*; the top of the head is like young female *salvini* or *maculata*; the ground color of the back is much like young female *maculata*, but it is more heavily marked than in adult female *maculata*, with the dark bars much broader and the pale tips buffy instead of light rufescent. The tail, at first glance, appears to be very differently marked, with only three or four light spots instead of the seven or eight black bars on a rufous ground as found in the *salvini* group, but a careful examination shows that these pale spots are bordered anteriorly and posteriorly by black, with an indistinct light space between each two successive black borders, so that a series of light and dark bars is actually present which may be correlated with the bars on the tail of *salvini*, although the spacing is quite different. One male of *salvini* at hand has one of the outer rectrices marked in a somewhat similar manner. The wing-pattern is only a little more pronounced than in young males of the *salvini* group. Even adult males of *salvini* sometimes show white tips on the upper wing-coverts preceded by a definite black subapical bar.

It is quite possible that the males of *lunulata* are so similar to those of *salvini* that they are confused with them in the material at hand, but there is no proof of any sort available. It is equally possible that some unexpected pattern will be found when males are definitely identified as belonging to this form. Since both *lunulata* and *salvini maculata* occur at Lagarto and at Sarayacu, the two species must be kept distinct until further evidence is forthcoming.

The Lagarto specimen of *lunulata* is not fully adult and differs from the Sarayacu example and from the published figure of the type in several respects which are to be attributed to its immaturity. Thus, the throat is partly brown like the breast, with a few white feathers suggesting the mature pattern. The upper part of the lores and the superciliary region are dull cinnamomeous instead of white. The sides of the mantle are nearly plain brown, with faint suggestions of the banded tips of the adult plumage, but the median line of this area and the scapulars also are occupied by feathers with the strongly marked adult pattern, making three stripes of banded feathers on the back. No molt appears to be in progress and, although the banded feathers are of somewhat firmer texture than the plainer ones, they may be equally juvenile. A slight area of white is concealed on the mantle as in the other two examples. The Yurimaguas bird and apparently also the Sarayacu specimen are adults.

I have considered the possibility that *lunulata* represents the female plumage of *G. leucaspis peruana*. The likelihood appears very remote although there are slight traces of *lunulata* pattern discernible on some parts of the plumage of certain individuals of the *leucaspis* group, and the white abdomen is suggested in *lunulata* by white shafts and pale median spots in this region.

There are no records of members of the *leucaspis* and *salvini* groups from the same locality although *l. peruana* occurs east of the lower Huallaga and *s. maculata* occurs west of the lower Ucayali while *lunulata* overlaps both ranges. The possibilities of *peruana* and *maculata* actually occurring together and of *lunulata* being a hybrid are, therefore, not excessively remote, although it is difficult to see in *lunulata* a hybridism of this sort.

The possibility of obscure relationship to *Hylophylax poecilonota lepidonota*, whose range coincides in part with that of *G. lunulata* and which has certain features of pattern in common with it, is probably very remote, but the resemblance may prove to be significant. Nevertheless, until *lunulata* can be identified with some other species or until its masculine plumage is ascertained, it must remain under its own name as a very peculiar species about which the last word has yet to be written.

SPECIMENS EXAMINED

G. lunulata.—PERÚ: Lagarto, 1 ♀; Yurimaguas, 1 ♀¹.

¹ Specimen in National Zoological Museum, Warsaw.

***Ramphocaenus melanurus amazonum* Hellmayr**

Ramphocaenus melanurus amazonum HELLMAYR, 1907, Novit. Zool., XIV, p. 66—Teffé, Rio Solimões, Brazil; ♂; American Mus. Nat. Hist. (Rothschild coll.).

Acquisition of the type of *amazonum* and various specimens from the Rio Madeira, not previously available, gives further assurance that the birds from Lagarto, right bank of the upper Ucayali, Perú, belong to this form.

Two birds from just north of the Marañón and one from Yurimaguas have also come to hand and permit the solution of the problem (1931, Amer. Mus. Novitates, No. 509, p. 3) concerning a bird of doubtful identity from the mouth of Lagarto Cocha, southeastern Ecuador. Since they all agree in characters which distinguish them from *amazonum* they may be separated as follows.

***Ramphocaenus melanurus badius*, new subspecies**

TYPE from the mouth of the Río Cinipá, Perú. No. 407,242, American Museum of Natural History. Adult male collected September 17, 1929, by José Schunke; original no. 306.

DIAGNOSIS.—Nearest to *R. m. amazonum* of the south bank of the Amazon and similarly without bright flanks, but median under parts less purely white; flanks averaging duller and grayer; upper surface brighter or warmer brown; auriculars darker, more ochraceous or brownish, less whitish.

RANGE.—Perú north of the Marañón and apparently also crossing it to the vicinity of the mouth of the Huallaga; southeastern Ecuador in the lowermost portion of the Río Napo.

DESCRIPTION OF TYPE.—Top of head light Argus Brown with a tinge of Auburn; back near Cinnamon Brown. Lores pale brownish buff; a very inconspicuous dull whitish superciliary line, hair-like and even less conspicuous over the eye than over the auriculars; postocular stripe like the top of the head; auriculars light brownish; chin, throat, and belly whitish; breast faintly buffy, deeper on the sides; flanks dull brownish gray. Remiges with exposed outer margins much like the back, somewhat paler on the primaries; upper wing-coverts similarly margined with warm brown; inner margins of remiges narrowly whitish; under wing-coverts dull whitish except the under primary-coverts which have a brownish tinge. Tail largely blackish; outermost pair of rectrices with terminal third of inner web and most of outer web somewhat paler and grayer, but not prominently so; subexternal pair with pale tips all but obsolete. Bill (in dried skin) with maxilla slightly reddish brown; mandible paler, flesh-colored along the lower margin; feet pale slaty gray. Wing, 53 mm.; tail, 42; exposed culmen, 22; culmen from base, 26.5; tarsus, 20.

REMARKS.—Female not certainly distinguishable from the male unless it should be found to average slightly smaller. Wing, 49 mm.; tail, 41.5; exposed culmen, 20; culmen from base, 24.5; tarsus, 19.5.

The two specimens, from Chayavitas and Santa Cruz, respectively, which Hellmayr found to be brighter and clearer brown above than the

type and Rio Madeiran skins of his *amazonum*, add further weight to the evidence of distinction for *badius*. A Yurimaguas specimen, also mentioned by Hellmayr and now before me, shows the same warm upper parts but has the auricular region paler than the type and two other paratypes of *badius*, being about as in the darkest extreme of *amazonum*. With few exceptions, however, *amazonum* has the auricular region conspicuously pale or even whitish, quite unlike *badius*.

Taczanowski's remark that a female from Yurimaguas had the tail entirely black may have had its origin in a specimen with this appendage incomplete. The female at hand from the mouth of the Río Santiago apparently has the tail entirely black, but the outermost (and some other) rectrices are missing. The Yurimaguas male has a tail like that of the type of *badius* which does not differ from the tail of *amazonum* in this respect. There is no approach toward the strongly marked tail of *obscurus*.

Specimens of *amazonum* from the lower Amazon average rather brighter above than skins from the upper Amazon, although some are quite similar, and also average paler on the lateral under parts where they sometimes have a buffy tinge suggesting a slight approach toward typical *melanurus*. Some of the brightest examples of this sort have the upper parts as warmly colored as *badius*, but the outer margins of the remiges remain duller, the top of the head is more strongly differentiated from the back, the auriculars are much more whitish, and the tinge of buff on the sides and flanks is far removed from the grayish tone of *badius*.

Additional specimens from the Pará district, including the right bank of the Tocantins, and from the eastern coast of Brazil show that the Pará form is not true *melanurus* but a distinct subspecies which has not been recognized heretofore. It may be known as follows.

***Ramphocaenus melanurus austerus*, new subspecies**

TYPE from Pedral, Baião, Rio Tocantins (right bank), Brazil. No. 431,327, American Museum of Natural History. Adult male collected December 11, 1931, by A. M. Olalla.

DIAGNOSIS.—Similar to *R. m. melanurus* of southeastern Brazil in respect to the presence of bright ochraceous lateral under parts, but the upper surface very much duller, grayish instead of tawny. Similarly grayer above than *R. m. amazonum* of the south bank of the Amazon, farther upstream, and in addition distinguishable by the bright flanks which are not found in *amazonum*.

RANGE.—Pará region, from the right bank of the Tocantins eastward to northern Maranhão.

DESCRIPTION OF TYPE.—Top of head hardly brighter than Buff Brown; hind

neck slightly brighter, passing into Light Brownish Olive on the back, somewhat darker on the rump. Lores and an inconspicuous superciliary line whitish; a wider postocular stripe the color of the crown; auriculars dull whitish basally, passing into Tawny-Olive \times Sayal Brown posteriorly and on the sides of the neck; chin, throat, and median line of belly white; middle of breast whitish, faintly buffy; sides of breast like sides of neck; flanks Pinkish Buff \times Cinnamon-Buff; under wing-coverts white; inner margins of remiges narrowly whitish; exposed outer margins of secondaries much like the back; those of primaries paler, near smoke gray; upper wing-coverts grayish brown, margined with the color of the back. Tail largely blackish, somewhat grayish on bases of lateral margins; outermost rectrices with terminal third of inner webs grayish and most of outer webs the same, becoming whitish in a very narrow marginal hair-line about the middle of the feather; tips of next two pairs narrowly pale, narrower on the antepenultimate feathers. Bill (in dried skin) brown on maxilla, paler brownish on mandible, with gonys and lower margins of the rami flesh-color; feet dull slaty. Wing, 50.5 mm.; tail, 45.5; exposed culmen, 20; culmen from base, 23.25; tarsus, 20.5.

REMARKS.—Female uncertain. A single bird of this sex from Palmares, Pernambuco, is a little brighter on the upper surface, though not so brightly colored as the specimens which I unhesitatingly refer to typical *melanurus*. With only a single specimen, the identification is not without some query, but the record may be left with *melanurus* for the present.

Similarly there is but a single specimen from Maranhão,—near Miritiba. This bird is somewhat faded, but is much less warmly colored above than the Pernambuco skin. The flanks are still rather bright ochraceous, whereas several faded Bahia skins, including the type of Wied's *Thryothorus gladiator*, have lost most of the bright color of the lateral under parts although the upper parts are still quite tawny, much brighter and warmer than any of the specimens of *austerus*, all of which are fresher.

There is just a possibility that the Bahian birds may represent a still different form with permanently pale flanks as noted. Without fresh material it is impossible to be sure. Wied [1830, 'Beitr. Naturg. Bras.,' III (2), p. 753] notes the sides and flanks of the type as strongly washed with "röthlich-graubraun," which is rather more applicable to the type, even in its present faded condition, than it is to the fresher skins from São Paulo and Santa Catharina. If Bahian birds are separable, Wied's name would seem to be available for them. However, such recognition would require the assignment of the Pernambuco skin to *austerus* where it seems to be out of place. Fresh material from Bahia is more likely to show that *Thryothorus gladiator* is a strict synonym of *Ramphocaenus m. melanurus*. Swainson's *Troglodytes rectiros-*

tris also is certainly a synonym of *melanurus* and not an earlier name for *austerus* since the original description refers to the bright coloration of the upper parts, the distinguishing feature of the southeast-Brazilian form.

***Ramphocaenus melanurus trinitatis* Lesson**

Ramphocaenus trinitatis LESSON, 1839, Rev. Zool., II, p. 42—"in insula Trinitatis"; type lost?

Additional material from northern Venezuela and Trinidad points to the necessity for further revision of the Venezuelan forms, only a portion of which is clearly demonstrable at this time. As remarked by Hellmayr [1924, Field Mus. Nat. Hist. Publ., Zool. Ser., XIII (3), p. 207, footnote a], specimens from Bermúdez are notably paler than the average from Trinidad, and I find other examples from the Cumaná region in better accord with them than with Trinidad birds. Hellmayr has stated that Bermúdez specimens form the transition to *pallidus* (of which I have no specimens of undoubted identity) and perhaps they should be referred to *pallidus* rather than to *trinitatis*. This is rendered plausible by the facts that on the upper Orinoco and the Caura a variation in the opposite direction occurs, and also that one skin from east of Bogotá, in Colombia, is indistinguishable from the Bermúdez and Cumaná birds. The continuity of this distribution has yet to be demonstrated but would be expected to follow somehow along the base of the Cordillera of Mérida to eastern Colombia. There appear to be no records from between the state of Lara, Venezuela, and eastern Colombia and it is possible that the range is broken through this region.

If the Cumaná and Bermúdez birds are referred to *pallidus*, the Trinidad form is cut off from the Orinoco. Specimens from the Paria Peninsula are exactly like the Trinidad specimens and should be referred to the same subspecies. Hellmayr already has pointed out the possibility of error in the application of the name "*trinitatis*," the original description of which applies better in some particulars to the bird later called *albiventris*. There is thus an obvious error either in description or in citation of type locality, and it is impossible to say which is correct without examination of the type, the whereabouts of which have not been ascertained. Until other evidence is forthcoming, I follow Hellmayr in the application of the name.

The upper Orinoco birds are quite recognizably distinct from the Trinidad specimens and even more decidedly separable from the Cumaná examples, which come from a region interposed between the

Paria Peninsula and the upper Orinoco Valley. They may be recognized as follows.

***Ramphocaenus melanurus duidae*, new subspecies**

TYPE from Esmeralda, Mt. Duida, Venezuela; altitude 325 feet. No. 275,047, American Museum of Natural History. Adult male collected October 7, 1928, by the Olalla brothers.

DIAGNOSIS.—Somewhat similar to *R. m. trinitatis* of the Island of Trinidad and northeastern Venezuela, but upper parts darker with the top of the head less strongly contrasted with the back; lateral under parts deeper ochraceous, more sharply defined from the white median area of the belly.

RANGE.—Southwestern Venezuela in the vicinity of Mt. Duida, northeastward along the upper Orinoco, and in the Caura Valley; apparently westward to the eastern face of the Andes in northeastern Ecuador.

DESCRIPTION OF TYPE.—Top of head dark Snuff Brown × Saccardo's Umber; hind neck a little brighter; sides of neck much brighter, clear Tawny × Cinnamon, including posterior part of auriculars; base of auriculars paler; a postocular stripe the color of the top of the head, from which it is separated by a narrow superciliary stripe the color of the sides of the neck; lores paler and more buffy; mantle Saccardo's Umber × Olive-Brown; rump darker and duller. Chin and throat clear white; breast light Cinnamon-Buff, deepening into Clay Color on the sides of the neck; flanks Clay Color, rather sharply defined from the center of the belly which is white; under tail-coverts buffy. Remiges sooty, with exposed outer margins warm brown; upper wing-coverts similar; under wing-coverts whitish, tinged with buff on under primary-coverts; inner margins of remiges narrowly whitish. Tail black with inconspicuously paler tips on the submedian to the subexternal rectrices; outermost feathers with terminal fourth and outer margins pale, especially near the middle of the outer margin, and with two poorly defined dark cross-bars near the tip. Maxilla (in dried skin) light brown, mandible flesh-color; feet dull slate. Wing, 48 mm.; tail, 44.75; exposed culmen, 21; culmen from base, 24; tarsus, 19.5.

REMARKS.—Females like the males.

The detail of pattern on the outermost rectrices varies in different individuals but usually shows a pale outer margin and a light tip of variable width, rarely approaching whiteness.

The birds from northeastern Ecuador approach *duidae* more closely than they do any other form, being similarly colored above and only a little less strongly marked on the lateral under parts.

The range extends down the Napo to the mouth of the Curaray, but at Lagarto Cocha, a short distance farther downstream is found the very different form, *badius*, described on an earlier page.

The material examined, including that reported on in the earlier paper and the specimens subsequently received, may be arranged as follows.

SPECIMENS EXAMINED

R. m. melanurus.—BRAZIL: São Paulo, Iguapé, 2 ♂; Santa Catharina, Palmital, 1 (?); Pernambuco, Palmares, 1 ♀; "Bahia," 3 (?); "Brasília," (?) (type of *Thryothorus gladiator*).

R. m. austerus.—BRAZIL: Maranhão, near Miritiba, 1 ♂; Ananindeua, 1 ♂; Rio Tocantins (right bank), Baião, 3 ♂; Pedral, Baião, 1 ♂ (type); Mocajuba, 1 ♂.

R. m. amazonum.—BRAZIL: Teffé, 1 ♂ (type); Boca Lago, Teffé, 2 ♂; Rio Madeira, Borba, 1 ♂, 2 ♀; Igarapé Auará, 1 ♂, 1 ♀; Calamá, 2 ♂, 1 ♀; Humaythá, 1 ♂; Rio Tapajoz, Igarapé Brabo, 5 ♂, 5 ♀; Aramanay, 1 ♂, 2 (?); Tauary, 2 ♂, 4 ♀; Rio Tocantins (left bank), Cametá, 1 (?). PERÚ: Río Ucayali (right bank), Lagarto, 1 ♂, 1 ♀.

R. m. sticturus.—BRAZIL: Matto Grosso, 1 ♀; Barão Melgaço, 1 ♂; Primavera, 1 ♀.

R. m. obscurus.—PERÚ: Río Ucayali (left bank), Santa Rosa, 3 ♂ (incl. type), 1 ♀.

R. m. badius.—PERU: mouth of Río Cinipá, 1 ♂ (type); mouth of Río Santiago, 1 ♀; Yurimaguas, 1 ♂. ECUADOR: mouth of Lagarto Cocha, 1 ♂.

R. m. albiventris.—BRITISH GUIANA: Tumatumari, 1 ♂; Annai, 1 ♂, 1 ♀. BRAZIL: Faro, 2 ♀.

R. m. trinitatis.—TRINIDAD: Pointe Gourde, 1 ♀, 1 (?); Caura, 1 ♀; Caparo, 1 ♂, 2 ♀; Princetown, 1 ♂, 2 ♀; Carenage, 2 ♂. VENEZUELA: Cristóbal Colón, 1 ♂, 1 ♀.

R. m. trinitatis (near *pallidus*).—VENEZUELA: Hills of Quebrada Secca, Cumaná, 2 ♀; Cumaná, 3 (?); La Tigrera, 1 ♂; Caripé, 1 (?); Cocallar, 1 ♂; Cuchivano, 1 (?); Cumanacoa, 1 ♂; San Antonio, 1 ♂, 1 ♀. COLOMBIA: Buena Vista, above Villavicencio, 1 ♀.

R. m. duidae.—VENEZUELA: Mt. Duida, Esmeralda, 4 ♂ (incl. type), 3 ♀; Caño León, 1 ♂, 4 ♀; Río Orinoco, Lalaja, 1 ♂; Munduapo, 1 ♂, 1 ♀; Nericagua, 1 ♂; Río Caura, Suapure, 3 ♂, 2 ♀; La Prición, 2 ♂, 1 ♀; Caura, 1 (?); Maripa, 1 ♂, 2 ♀ (?); Río Cassiquiare, El Merey, 1 ♂, 1 ♀; opposite El Mercy, 1 ♂, 1 ♀. ECUADOR: lower Río Suro, 1 ♂, 1 ♀; mouth of Río Curaray, 1 ♂; Río Napo, 1 (?).

R. m. griseodorsalis.—COLOMBIA: Miraflores, 1 ♂ (type); El Roble, 1 ♂ Dabeiba, 1 ♂.

R. m. sanctae-marthae.—COLOMBIA: Santa Marta, Concha, 1 ♂; Bonda, 2 ♂, 5 (?).

R. m. rufiventris.—ECUADOR: Chimbo, 1 ♂; Esmeraldas, 1 ♂; Portovelo, 2 ♂; Bucay, 1 ♂; Alamor, 1 ♀ (?); Naranjo, 1 ♀ (?). PANAMÁ: 19 ♂, 14 ♀ 3 (?). COSTA RICA: 1 ♂, 6 ♀. NICARAGUA: 8 ♂, 7 ♀. GUATEMALA: 8 ♂, 1 ♀, 3 (?).

AMERICAN MUSEUM NOVITATES

Number 918

Published by
THE AMERICAN MUSEUM OF NATURAL HISTORY
New York City

May 1, 1937

SOME MINERAL INCRUSTATIONS SELECTIVE UPON CRYSTAL FORMS

BY CLIFFORD FRONDEL

SPHALERITE INCRUSTING GALENA

Crystallization upon the surface of a crystal bounded by several forms may be so ordered that deposition takes place upon the faces of one of the forms only. The effect is caused by the relatively greater adsorptive power of such faces, which facilitates the development of crystal nuclei upon them and localizes the ensuing crystallization. Among a number of such instances that have been described are incrustations of bournonite and of pyrite upon the (100) faces of galena cubo-octahedrons in preference to the (111) faces, and of chalcopyrite upon the (111) faces in preference to the (100) faces.

An additional instance of selectivity in deposition upon the crystal forms of galena is afforded by a specimen of sphalerite and galena from Freiberg, Germany, presented to the American Museum by Mr. Ernest Weidhaas. The specimen exhibits a number of interlocking galena cubo-octahedrons, averaging about 1.5 cm. in size, arranged upon drusy quartz. The (111) faces of the crystals are overgrown by closely aggregated sphalerite crystals that range in size up to 0.5 mm. A few minute chalcopyrite crystals are interspersed with the sphalerite crystals. The (100) faces of the galena crystals are either entirely free from the incrustation, or are occupied by a few scattered crystals only. The incrusting crystals are slightly embedded in the surface of the galena, and evidently were deposited while the galena was still growing.

The sphalerite crystals are not parallelly arranged upon the incrustated faces. It cannot be concluded, however, that the crystals are not oriented to the galena. A number of different orientations may be present, and the distribution of the incrusting crystals among these orientations may not be such as to give the effect of parallelism. A parallel arrangement would be noticeable to the eye only if the incrusting crystals were predominantly oriented in a particular position.

SELECTIVELY COATED QUARTZ CRYSTALS

The absorption of a foreign substance selectively by the forms of a quartz crystal is not uncommon. The $(10\bar{1}1)$ faces of quartz may thus be selectively filmed by colloidal iron oxide or colloidal clay material, while the $(01\bar{1}1)$ and $(10\bar{1}0)$ faces remain unfiled (Fig. 1).

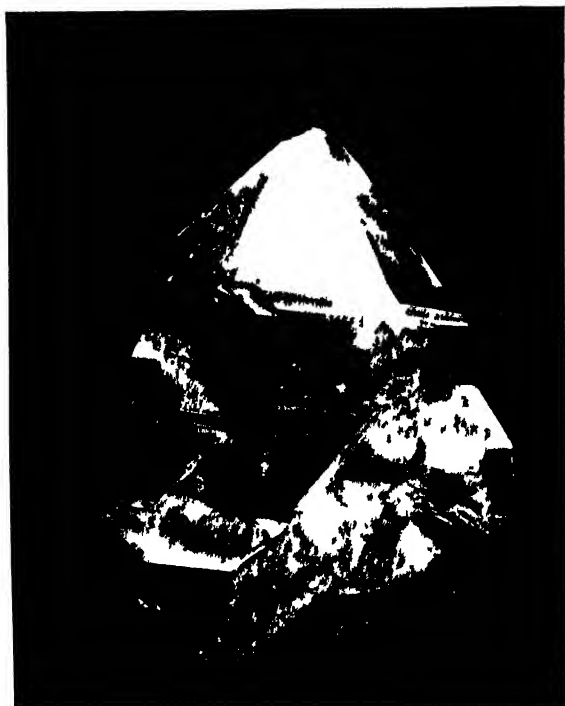


Fig. 1. A selectively coated quartz crystal. The faces of $(10\bar{1}1)$ have included during the last stages of growth of the crystal an amount of colloidal clay substance, while the faces of $(01\bar{1}1)$ and $(10\bar{1}0)$ are not coated and present the ordinary transparent quartz of the crystal. The clay charged zone is cream white in color and is about 1 mm. thick. Alexander County, North Carolina. $\times 1/2$

Similarly, the pigmenting substance of amethyst is frequently adsorbed, during the growth of the crystal, by the faces of $(10\bar{1}1)$ in preference to the faces of other forms that are present on the crystal. The effect gives rise to a three-fold segmental coloration in cut basal sections of amethyst. Smoky quartz crystals sometimes exhibit a similar distribution of the pigmenting substance.

A suite of quartz crystals recently donated by Dr. A. C. Hawkins presents a further instance of selective deposition. The specimens were found embedded in clay, apparently arising from the decomposition *in situ* of the feldspar of a pegmatite, at La Grange, Troup County, Georgia. The forms present on the crystals are $(10\bar{1}1)$, $(01\bar{1}1)$, $(10\bar{1}0)$ and $(11\bar{2}1)$. Both right- and left-handed crystals are represented. The faces belonging to $(10\bar{1}1)$ and $(11\bar{2}1)$ have included, during the last stages of growth of the crystals, an amount of grayish white foreign material. This matter occupies a uniform, translucent zone about 0.1 mm. thick at the surface of these forms. The other faces and the interior of the crystals are colorless and transparent (Fig. 2). On a few

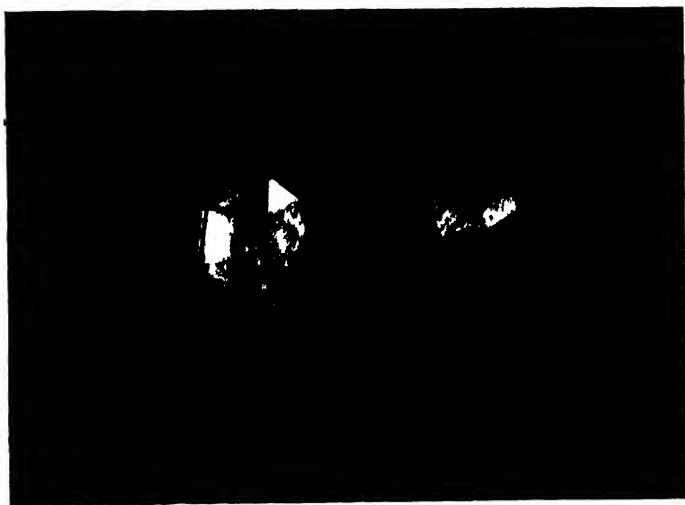


Fig. 2. Quartz crystals exhibiting a selective coating of the faces of $(10\bar{1}1)$; the three alternating faces of $(01\bar{1}1)$ are not coated. The crystals are viewed along the *c*-axis. La Grange, Troup County, Georgia. $\times 3$

crystals, however, the faces of $(10\bar{1}0)$ are coated in addition to those of $(10\bar{1}1)$ and $(11\bar{2}1)$. The coating is invariably absent from the faces of $(01\bar{1}1)$. The weak adsorbing power of this form appears to be characteristic of quartz. The included substance cannot be resolved under the microscope and its nature is unknown. The mode of occurrence of the quartz crystals, however, suggests that it may be colloidal clay substance, similar to the so-called *cotterite* variety of quartz.

CHALCOPYRITE INCRUSTING SPHALERITE

An incrustation of chalcopyrite selective upon the forms of sphalerite was noted on a specimen of sphalerite in association with bournonite and quartz from Casapalca, Peru. The sphalerite crystals present large faces of $(1\bar{1}1)$ and (110) with minor (111) and, occasionally, (100) . The crystals are distorted and complexly twinned. The chalcopyrite occurs as a very thin, even crust over the faces of $(1\bar{1}1)$ and is lacking on the faces of the other forms. The incrusting crystals exhibit a marked tendency for distribution along the edges of growth terraces and striations present on the $(1\bar{1}1)$ faces. Where the incrustation is dense this effect is obscured and the entire face is uniformly overgrown.

The individual chalcopyrite crystals composing the crust are too minute to be distinguished by the unaided eye. That the crystals are oriented to the sphalerite is proved by the appearance of a bright satin-like sheen, due to simultaneous reflection from many parallel crystal facets, when the crust is held in certain angles.

AMERICAN MUSEUM NOVITATES

Number 919

Published by
THE AMERICAN MUSEUM OF NATURAL HISTORY
New York City

May 1, 1937

NEW AMERICAN LYCOSIDAE WITH NOTES ON OTHER SPECIES

BY W. J. GERTSCH AND H. K. WALLACE

The types of the new species described below are deposited in the collection of The American Museum of Natural History.

PARDOSA C. KOCH

Pardosa sagei, new species

Figures 1 and 2

MALE.—Total length, 5.40 mm. Carapace, 2.90 mm. long, 2.10 mm. wide.

Carapace light to dark brown, with a pale median dorsal stripe which is narrowest on the posterior declivity, is expanded around the dorsal groove, is constricted in front of the groove and then is abruptly expanded again to become as wide as the distance between the posterior eyes, projecting forward into and blending with the black of the ocular region. Sides of the carapace with a more or less serrate yellowish submarginal band. Clypeus and sides of the head yellowish, the clypeal margin tinged with black. The extent of the light areas varies in the paratypes, particularly in the males. Dorsum of the abdomen dark except for a reddish hastate marking which is followed by a white maculation. Venter of the abdomen, sternum, mouth parts, coxae and ventral surfaces of the legs yellowish, with a scanty dark maculation. Dorsal surfaces of the femora banded. Palpi provided with a dense brush of black hairs on all joints except the dorsal surfaces of the patellae and femora. In some males the venter of the abdomen is almost black and all the joints of the palpi are black. The white hairs on the patellae of the palpi are usually present and are particularly striking in the living spiders. Chelicerae, 1.10 mm. long.

Posterior eye quadrangle wider than long (1.30 mm./0.90 mm.), the posterior median eyes (second row) larger than the posterior laterals (posterior row) in the ratio of 40:35. Anterior row of eyes narrower than the second row (0.70 mm./1.00 mm.), moderately procurved, the median eyes larger than the laterals, the eyes about equidistantly spaced. Clypeus, 0.40 mm., about equal in height to the diameter of a posterior median eye.

Leg formula, 4123, the lengths of the legs in that order, 11.50 mm., 8.80 mm., 8.25 mm., 8.10 mm. Tibia and patella of the first leg, 3.10 mm., of the fourth leg, 3.40 mm. long.

FEMALE.—Total length, 6.40 mm. Carapace, 3.00 mm. long, 2.40 mm. wide.

Color and pattern essentially as in the male but the legs are more distinctly annulated, the annulations on the femora, tibiae and metatarsi. Posterior eye quadrangle wider than long (1.30 mm./1.00 mm.), the eyes of the second row larger than the posterior eyes (0.50 mm./0.40 mm.). First row of eyes narrower than the sec-

ond (0.75 mm./1.10 mm.), slightly procurved, the median eyes larger than the laterals. Clypeus, 0.50 mm.

Leg formula, 4123, the lengths of the legs in that order, 12.10 mm., 8.90 mm., 8.40 mm., and 8.30 mm. long, respectively. Tibia and patella of the first leg, 3.20 mm., of the fourth leg, 3.80 mm. long.

TYPE LOCALITY.—Male holotype, female allotype and male and female paratypes from around the lakes near Miller's Ranch, El Volcan, Chiriqui, Panama, February 26, 1936 (W. J. Gertsch). Numerous paratypes of both sexes taken at this same locality during late February and early March, 1936 (W. J. Gertsch).

This species is a representative of the complex of forms of which *Pardosa pauxilla* Montgomery, *delicatula* Gertsch and Wallace and *bellona* Banks are examples. It may be separated from these forms by reference to the genitalia, in the male particularly by the shape of the median apophysis of the palpus.

Pardosa chiapasiana, new species

Figure 3

Pardosa delicata GERTSCH, 1934, American Museum Novitates, No. 693, p. 20 (male allotype, not female holotype).

MALE.—Carapace, 2.10 mm. long, 1.70 mm. wide.

The specimen is in poor condition, the abdomen and some of the legs being lost. Carapace dark brown to black, with a wide median longitudinal pale stripe which does not extend between the eyes and with a submarginal denticulate pale band on each side. Eye region black. Sternum, coxae, labium and endites yellow. Last leg all yellow. Clypeus and chelicerae black. All the joints of the palpus dark.

Structure essentially as in other species of the genus. Posterior eye quadrangle wider than long (1.00 mm./0.80 mm.), the eyes of the second row larger than the posterior eyes (0.40 mm./0.30 mm.). Anterior row of eyes narrower than the second row (0.80 mm./0.60 mm.), moderately procurved, the median eyes larger than the laterals, the eyes equidistantly spaced. Clypeus scarcely as high as the diameter of an eye of the second row. Tibia and patella of the fourth leg, 2.00 mm. Male palpus as figured.

TYPE LOCALITY.—Male holotype from La Zacualpa, Chiapas, Mexico, August, 1909 (Dr. Alexander Petrunkevitch), in the collection of The American Museum of Natural History.

This species is characterized particularly by the palpus which has a general resemblance to those of *Pardosa sternalis* (Thorell) and *P. saxatilis* (Hentz). From both of these it differs in having a more slender scopus (median apophysis) which is curved and greatly narrowed in the terminal portion. The single specimen was erroneously placed as the male of *Pardosa delicata* Gertsch, a species which is more properly associated with *Pardosa delicatula* Gertsch and Wallace, *P. pauxilla*

Montgomery, etc., and the male of which will probably resemble the species of that group.

Pardosa floridana Banks

Pardosa littoralis BANKS, 1896, Journal New York Entomological Society, IV, p. 192.

Pardosa floridana BANKS, 1904, Proc. Acad. Nat. Sci. Philadelphia, p. 136, Pl. VII, fig. 1, Pl. VIII, fig. 15.

Pardosa banksi CHAMBERLIN, 1904, Canadian Entomologist, XXXVI, p. 175. (New name for *littoralis* Banks, preoccupied.)

Pardosa ocala BRYANT, 1935, Psyche, XLII, p. 81, Pl. v, fig. 12.

This spider is a common form along the Atlantic coast from Long Island, New York, to Florida, and also occurs in Cuba. A careful study of a cotype of *Pardosa ocala* has convinced us that the characters on which this name was based are not specific.

Pardosa orophila Gertsch

Pardosa orophila GERTSCH, 1933, American Museum Novitates, No. 636, p. 28, Fig. 45.

Pardosa yavapa GERTSCH AND WALLACE, 1935, American Museum Novitates, No. 794, p. 3, Fig. 9. (Not *yavapa* Chamberlin, Figs. 2 and 6.)

RECORD.—Six miles south of Whiteriver, Arizona, July 31, 1936, four females (Hustace H. Poor and Frank G. Watson).

The two previously known examples of this small species were thought to represent aberrant specimens of *Pardosa yavapa* Chamberlin, a widely distributed species of the southwestern United States. However, the acquisition of additional material (mature females with egg sacs) shows that the important differences in the epigynum are constant. The male is unknown but will undoubtedly resemble the males of *Pardosa yavapa* Chamberlin and *P. montgomeryi* Gertsch.

ARCTOSA C. KOCH

Arctosa floridiana (Banks)

Trochosa floridiana BANKS, 1893, Trans. American Ent. Soc., XXIII, p. 72.

Lycosa floridiana CHAMBERLIN, 1908, Proc. Acad. Nat. Sci., Philadelphia, p. 283.

Arctosa seminola PETRUNKEVITCH, 1911, Bull. American Museum Nat. Hist., XXIX, p. 552.

Arctosa absoluta GERTSCH, 1934, American Museum Novitates, No. 726, p. 9, Fig. 1.

The male of this species was described and figured for the first time as *Arctosa absoluta* by Gertsch. It is a widely distributed form in the southeastern United States and has been taken as far west as western Texas. The carapace is often pale and marked with two

longitudinal dark bands but in many examples the pale stripes are completely obliterated by dusky chromatism, leaving the whole carapace nearly black.

Arctosa paraguensis, new species

Figure 10

MALE.—Total length, 3.85 mm. Carapace, 2.15 mm. long, 1.40 mm. wide.

Carapace dark brown, marked with a few pale streaks above, clothed sparsely with gray hairs. Sternum and coxae pale yellow, the labium and endites dusky, clothed with fine black hairs. Chelicerae dark brown, set with fine long hairs. First two femora dark brown, the distal joints of the first two pairs of legs pale yellow. Third femur dark brown, the patella and tibia annulate in brown, the distal joints of the third leg dusky yellow. Fourth femur dark brown, the patella, tibia and metatarsus distinctly annulate in brown, the tarsus pale yellow. Clothing of the legs black hairs and strong spines. Abdomen dark on the sides, the dorsum with a yellow median longitudinal band which is narrowed behind and which encloses a dark basal hastate marking. Venter of the abdomen dusky yellow.

Carapace longer than broad, narrowed in front, the width at the last eye row more than half the greatest width (43/70). Carapace moderately high, equal in height back to the longitudinal median groove, the posterior declivity declining moderately. Eyes of the first row weakly procurved, a line along the lower margins of the medians cutting the centers of the laterals, the medians separated by about their radius, one-third as far from the subequal laterals. Clypeus equal in height to two-thirds the diameter of an anterior median eye. Second eye row wider than the first (5/4), the eyes separated by their diameter. Third row of eyes three-fourths as wide as the head at that point, the eyes separated by two and one-half times their diameter. Dorsal eye quadrangle broader than long (60/45), narrowed in front (60/50), the anterior eyes larger. Chelicera nearly three times as long as broad, the lower margin armed with three subequal teeth. Sternum longer than broad (50/40). Labium as broad as long.

Leg formula, 4123. Tibiae and metatarsi with 2-2-2 ventral spines. First tibia unarmed above, the third and fourth tibiae with a weak basal and a stronger median spine.

	FEMUR	PATELLA	TIBIA	METATARSUS	TARSUS	TOTAL
I	1.13	0.60	0.90	1.00	0.70	4.33 mm.
II	1.05	0.58	0.75	0.92	0.56	3.86 mm.
III	1.05	0.55	0.65	1.05	0.55	3.85 mm.
IV	1.42	0.73	1.15	1.63	0.75	5.68 mm.

Palpus similar in structure to other species of the genus, differing chiefly in the details of the apophyses of the bulb. The terminal apophysis is a curved lobe which is directed toward the median apophysis and ends in a short hook. The median apophysis is a strong black hook which curves ventrad and, unlike comparable species of the genus, lacks an accessory ventral spur.

TYPE LOCALITY.—Male holotype from Taquarapa, Alto Parana, Paraguay (Fiebig, collector).

This small species is equivalent structurally to most of the other species of the genus, particularly those previously referred to *Allocosa*, but is easily separated by the details of the palpus and the distinctive color pattern.

PIRATA SUNDEVALL

Pirata piratica (Olivier)

Araneus piraticus CLERCK, 1757, 'Svenska Spindl.', p. 102, Pl. v, tab. 4.

Aranea piratica OLIVIER, 1789, 'Encyclopedie Methodique,' IV, p. 218.

Pirata prodigiosa KEYSERLING, 1876, Verh. Zool.-Bot., Gesell. Wien, XXVI, p. 669, Pl. II, fig. 2.

Lycosa febriculosa BECKER, 1881, 'Comptes-Rendus Soc. Entom. Belgique,' p. xlv, Pl. II, fig. 2.

Lycosa wacondana SCHEFFER, 1904, Entomological News, Philadelphia, XV, p. 260, Pl. XVII, fig. 7.

Pirata piraticus var. *utahensis* CHAMBERLIN, 1908, Proc. Acad. Nat. Sci., Philadelphia, p. 313.

Pirata febriculosa, CHAMBERLIN, 1908, idem, p. 311, Pl. XXII, fig. 1, and Figs. 1 and 2.

The name of the common European spider, *Pirata piratica* (Olivier), was first applied to an American species in 1885 by Emerton who erroneously identified it with a form subsequently described as *marxi* by Stone. A study of authentic examples of *piratica*, kindly sent to us by Dr. E. Schenkel of Basel, Switzerland, shows that the species is identical with *Pirata febriculosa* Becker. The synonymy is given above.

HESPEROCOSA, NEW GENUS

A genus of the subfamily Lycosinae.

Carapace much longer than wide, the pars cephalica broad, weakly rounded on the sides, seven-tenths as wide as the greatest width of the carapace. First row of eyes procurved, the medians slightly nearer the subequal laterals. Second row of eyes broader than the first (11/8), narrower than the posterior row (11/13). Dorsal eye quadrangle broader than long (13/11), slightly narrowed in front, the anterior eyes larger. Clypeus low, about equal in height to the diameter of an anterior median eye. Chelicera armed with two subequal teeth on the lower margin, three on the upper. Labium slightly broader than long. Leg formula, 4123, the tibiae armed with 2-2-2 ventral spines, the last pair apical, the first two tibiae unarmed above, the last two with basal and submedian spines. Median apophysis of the male palpus lateral in position, structurally much as in typical members of *Lycosa*. Embolus long, the truncus free of the pars pendula for half the length.

GENOTYPE.—*Schizocosa unica* Gertsch and Wallace (1935, American Museum Novitates, No. 794, p. 9, Figs. 21 and 22).

This interesting species is much smaller than any known *Lycosa*. The presence of only two teeth on the lower margin of the chelicera

will separate it from species of that genus. Structurally the species approximates the European species of *Xerolycosa* and to a lesser degree *Tarentula*, genera in which the cheliceral armature is the same, but the pronounced differences in the genitalia are sufficient to separate it.

LYCOSA LATREILLE

Lycosa tigana Gertsch and Wallace

Figure 6

Lycosa tigana GERTSCH AND WALLACE, 1935, American Museum Novitates, No. 794, p. 14, Fig. 32.

FEMALE.—Total length, 15.10 mm.

Legs and body yellowish brown. Carapace with a wide median light stripe which is not sharply delimited from the dark sides and which extends between the posterior eyes. Sides of the carapace with a light marginal band, otherwise brown, covered with black pubescence. Abdomen light brown, with a dark basal hastate marking, but lacking any other distinctive maculations. Femora lighter in color than the sternum, coxae and joints of the legs. Labium and endites dark; the chelicerae black. Venter with a black area which is roughly triangular in shape, the apex directed caudad. Spining of the legs as usual except for the ventral surfaces of the first tibiae, the normal three pairs of spines present but short and stout, less than half as long as the distance separating the different pairs.

Carapace longer than wide (7.30 mm./5.30 mm.), of the usual height proportionately (2.70 mm.), the width of the head about three-fifths the width of the carapace (3.70 mm.). Dorsal eye quadrangle wider than long (24/19), the anterior eyes larger than the posteriors (9/8). Anterior row of eyes distinctly procurved (a line through the centers of the anterior median eyes passes through the upper one-sixth of the anterior laterals), the anterior median eyes twice as large as the laterals, closer to each other than to the laterals. Clypeus scarcely as high as the diameter of an anterior median eye. Chelicera, 3.30 mm. long, the furrows armed as usual. Labium as long as wide (1.30 mm.). Sternum longer than wide (2.90 mm./2.60 mm.). Leg formula, 4123.

	FEMUR	PATELLA	TIBIA	METATARSUS	TARSUS	TOTAL
I	5.60	3.00	4.40	3.80	2.70	19.50 mm.
II	5.25	2.80	4.00	3.80	2.60	18.45 mm.
III	4.90	2.55	3.45	4.50	2.90	18.30 mm.
IV	6.20	3.00	5.10	6.20	3.40	23.90 mm.

RECORD.—Edinburg, Texas, July, 1935, female allotype (Stanley Mulaik).

The female of this species is described for the first time in this paper. As in the case of the male the female shows affinities to *Lycosa lenta* Hentz and several other closely related species. However, it can be separated from *lenta* by differences in the form of the epigynum and the spining of the first tibiae, and from other species by the

absence of bands on the legs as well as differences in the structure of the epigynum.

Lycosa ceratiola Gertsch and Wallace

Figure 8

Lycosa ceratiola GERTSCH AND WALLACE, 1935, American Museum Novitates, No. 794, p. 13, Fig. 27.

MALE.—Total length, 12.20 mm.

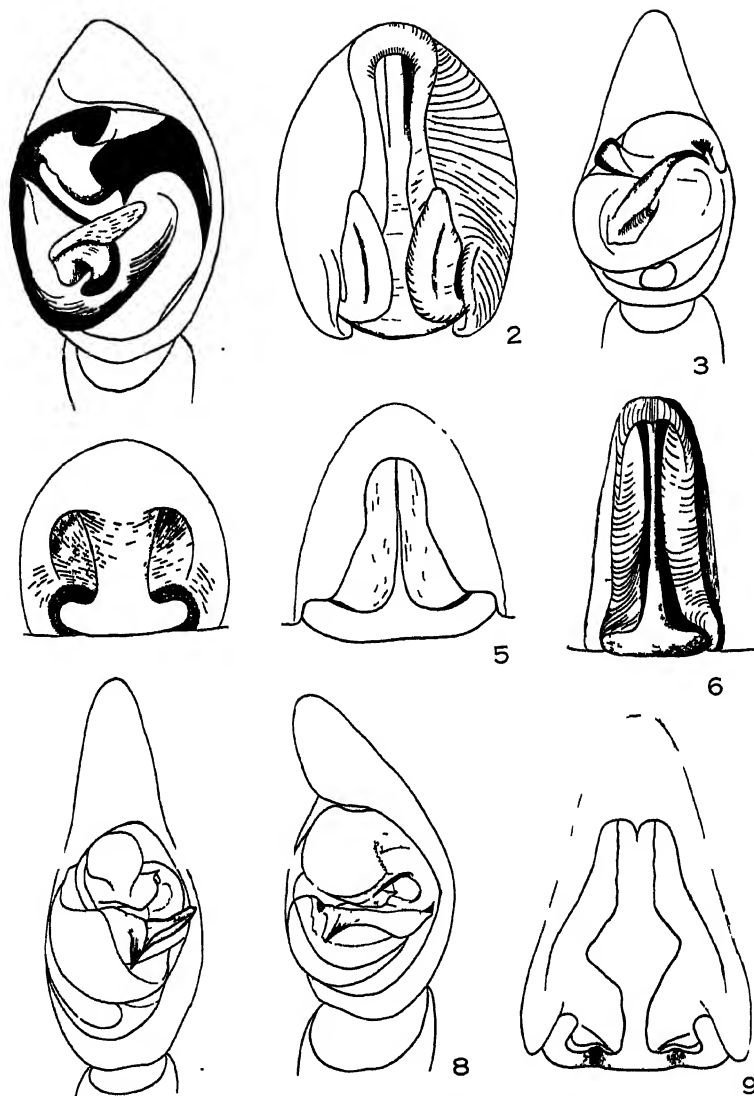
Color and markings essentially as in the female. Carapace with wide reddish-yellow marinal areas covered with white pubescence. Sides sparsely covered with white and black pubescence. Median dorsal stripe narrow caudally, widening abruptly about one diameter of a posterior lateral eye in front of the dorsal groove and enclosing dark spots, passing forward between the eyes where it is obscured by a thick matting of white hairs. Eyes incompletely surrounded by black; the clypeus dusky. Dorsum of the abdomen gray, covered with white pubescence and short black bristles. A hastate marking and two black spots are faintly indicated. Legs almost white beneath, somewhat darker above, the metatarsi and tarsi of the first and second pairs reddish brown, none of the legs with indications of annulations. Sternum, coxae, labium, maxillae and chelicerae black. Venter of the abdomen black. Anterior spinnerets twice as long and stouter than the posteriors.

Carapace longer than broad (7.20 mm./5.40 mm.), scarcely half as high as the width (2.40 mm.). Dorsal eye quadrangle wider than long (23/18), the anterior eyes larger than the posteriors (9/8). Width of the face, 3.10 mm. Anterior row of eyes shorter than the second row (15/20), slightly procurved, the medians twice as large as the lateral eyes, placed nearer the laterals. Clypeus about as high as the diameter of an anterior lateral eye. Chelicera, 3.00 mm. long, exclusive of the claw, 2.70 mm. wide. Lower margin of the furrow of the chelicera armed with three medium-sized teeth equal in size and equally spaced, the upper margin with three unequal teeth, unequally spaced, the median the largest. Labium longer than wide (1.20 mm./1.00 mm.), the basal excavations not reaching the middle. Sternum longer than wide (2.90 mm./2.60 mm.).

Leg formula, 4123, the spining normal, the ventral spines on the first and second tibiae not reduced in size as in the female.

	FEMUR	PATELLA	TIBIA	METATARSUS	TARSUS	TOTAL
I	6.80	3.20	5.80	6.00	3.60	25.40 mm.
II	6.70	3.10	5.50	6.10	3.50	24.90 mm.
III	6.20	2.70	4.80	6.20	3.50	23.40 mm.
IV	7.50	2.90	6.60	8.40	4.00	29.40 mm.

RECORDS.—Eustis, Lake County, Florida, June 25, 1935, males and females. Jensen, Martin County, Florida, July 4, 1935, males and females. West Palm Beach, Palm Beach County, Florida, February 14, 1936, males and females. Male allotype from Lake County, Florida, June, 1935.



- Fig. 1. *Pardosa sagei*, new species, ventral view of male palpus.
 Fig. 2. Idem, epigynum of female.
 Fig. 3. *Pardosa chiapasiana*, new species, ventral view of male palpus.
 Fig. 4. *Lycosa iviei*, new species, epigynum of female.
 Fig. 5. *Lycosa maasi*, new species, epigynum of female.
 Fig. 6. *Lycosa tigana* Gertsch and Wallace, epigynum of female.
 Fig. 7. *Lycosa osceola*, new species, ventral view of male palpus.
 Fig. 8. *Lycosa ceratiola* Gertsch and Wallace, ventral view of male palpus.
 Fig. 9. *Lycosa osceola*, new species, epigynum of female.

Females collected outside of the type locality show a certain amount of variation in the structure of the epigynum. In the epigynum of the holotype the median ridge is conspicuously expanded and the lateral depressions are correspondingly wide, whereas this expansion is totally lacking and the lateral depressions are quite narrow in specimens from Palm Beach, Martin and some parts of Lake Counties. In some specimens the epigyna are very similar to those of *Lycosa lenta* Hentz, in others the median ridge and lateral depressions are sinuous. The males appear to be quite free from variations. They can be distinguished from closely related species by differences in the pattern on the carapace and in the structure of the palpi.

Lycosa osceola, new species

Figures 7 and 9

MALE.—Total length, 20.00 mm.

Legs and body strikingly and densely covered with gray pubescence which is particularly well developed on the chelicerae, coxae, trochanters and margins of the carapace. Carapace reddish brown, without markings or pattern except for a few scattered dark spots. Eyes incompletely surrounded by black. Abdomen a dirty yellow-gray, unmarked, covered with a dense gray pubescence and numerous closely-set, black bristles. Third and fourth legs and femora and patellae of the first and second brownish yellow above; the distal halves of the first and second tibiae chestnut, the metatarsi and tarsi of these legs black, densely covered with gray hairs. All femora and the tibiae of the third and fourth legs yellow beneath. All joints of the palpi reddish yellow except the cymbia which are dark chestnut. Chelicerae, endites and coxae dark chestnut, almost black. Sternum black. Venter of the abdomen black.

Carapace longer than broad (11.90 mm./9.40 mm.), 3.20 mm. high. Width of the face, 5.40 mm. Dorsal eye quadrangle wider than long (3.20 mm./2.20 mm.), the anterior eyes larger than the posteriors (12/9). Anterior row of eyes straight, distinctly shorter than the second row (26/23), the lateral eyes slightly more than half as large as the medians, the eyes equidistantly spaced. Clypeus fully as high as the diameter of an anterior median eye. Chelicera, 4.80 mm. long, exclusive of the claw, 4.80 mm. wide. Lower margin of the furrow of the chelicera armed with three teeth, the medians equal in size and larger than the lateral; the upper margin with three unequal teeth, unequally spaced, the median the largest. Labium as long as wide (1.80 mm.), the basal excavations short. Sternum longer than wide (5.20 mm./4.10 mm.).

Leg formula, 4123, the spining as usual, the legs without indications of dark annulae.

	FEMUR	PATELLA	TIBIA	METATARSUS	TARSUS	TOTAL
I	11.50	5.20	9.70	11.80	5.60	43.80 mm.
II	10.90	5.10	8.90	11.30	4.50	40.70 mm.
III	10.00	4.40	7.60	10.90	5.00	37.90 mm.
IV	11.90	4.90	9.60	15.30	5.80	47.50 mm.

FEMALE.—Total length, 29.00 mm.

Legs and body less strikingly covered with gray pubescence than in the male. Color and markings similar to the male. Abdomen grayish yellow above, not as dark as in the male. Legs stout.

Carapace longer than broad (14.20 mm./10.90 mm.), 4.80 mm. high. Width of the face, 7.30 mm. Posterior eye quadrangle wider than long (3.80 mm./2.80 mm.), the anterior eyes larger than the posteriors (13/10). Anterior row of eyes shorter than the second row (27/30), slightly procurved (a line passing through the centers of the median eyes passes through the upper third of the laterals), the lateral eyes more than half as large as the medians, the medians closer to each other than to the laterals. Chelicerae, 7.00 mm. long, exclusive of the claw, 7.00 mm. wide. Chelicerae armed as in the male. Labium as long as wide, the basal excavations less than half the length of the labium. Sternum longer than wide (5.60 mm./4.80 mm.).

Leg formula, 4123.

	FEMUR	PATELLA	TIBIA	METATARSUS	TARSUS	TOTAL
I	10.90	5.80	8.50	8.90	3.90	38.00 mm.
II	10.30	5.50	7.80	8.80	4.20	36.60 mm.
III	9.40	5.00	6.80	9.30	4.50	35.00 mm.
IV	11.50	5.30	8.90	13.60	5.20	44.50 mm.

TYPE LOCALITY.—Male holotype, female allotype and paratypes from Eustis, Lake County, Florida, June 25, 1935 (H. K. Wallace). Paratypes of both sexes from Eustis, June 14, 1935 (W. Ivie, W. J. Gertsch, A. F. Carr, Jr. and H. K. Wallace). Paratypes of both sexes from Jensen, Martin County, Florida, July 4, 1935 (Louise and Irving J. Cantrall and H. K. Wallace). The holotype, allotype and paratypes are in the collection of The American Museum of Natural History. Other paratypes are in the collections of the University of Utah and of H. K. Wallace.

This fine species is equivalent to *Lycosa carolinensis* Walckenaer in size and is somewhat similar to *Lycosa lenta* Hentz and *Lycosa ceratiola* Gertsch and Wallace in appearance. It can be distinguished from *carolinensis* in the absence of black bands on the ventral surfaces of the legs and by differences in structure of the epigyna and palpi. It is distinct from *lenta* in size but more particularly by differences in the genitalia which are figured. *Lycosa osceola* is much larger than *ceratiola* and lacks the characteristic pattern on the carapace of that species.

Lycosa bellamyi, new species

Figure 14

FEMALE.—Total length, 13.00 mm. Carapace, 5.50 mm. long, 4.60 mm. wide.

Carapace dark reddish brown except for a median longitudinal paler band which, beginning between the eyes of the dorsal quadrangle, is as wide as the interval be-

tween the posterior eyes and narrows gradually to half that width at the caudal margin. Clothing of the carapace short black hairs with which are interspersed a few white ones. Chelicerae almost black, clothed with black hairs. Endites, sternum, coxae and legs reddish brown, concolorous with the pale dorsal stripe of the carapace clothed thinly with black hairs, the metatarsi and tarsi of the first two pairs of legs ventrally scopulate, the tarsi of the last two pairs with scopular hairs. Abdomen grayish brown above, marked with numerous small pale spots, clothed with black hairs, the base with a patch of white hairs. Venter of the abdomen dark brown to black, with two longitudinal rows of inconspicuous pale spots.

Carapace longer than broad, heavy, the width of the head at the large eyes of the second row, 2.50 mm. Sides of the carapace broadly rounded, the cephalic sutures obsolete, the median groove longitudinal. Sides of the carapace convex. First row of eyes narrower than the second (20/26), moderately procurved, the medians separated by three-fourths their diameter, half as far from the small laterals. Clypeus equal in height to the diameter of an anterior lateral eye. Eyes of the second row narrower than the third row (13/17), separated by scarcely a diameter (22/25). Third row of eyes about two-thirds as wide as the width of the carapace at that point (17/28), separated by scarcely three diameters. Median ocular quadrangle broader than long (17/12), narrowed in front (17/13), the anterior eyes larger. Chelicera with three large subequal teeth on the lower margin and three on the upper of which the median is larger. Labium as long as broad, half as long as the subparallel endites.

Leg formula, 4123. All tibiae and metatarsi with three pairs of ventral spines. First tibiae unarmed above, the fourth pair with strong basal and submedian dorsal spines.

	FEMUR	PATELLA	TIBIA	METATARSUS	TARSUS	TOTAL
I	4.50	2.30	3.50	3.15	1.75	15.20 mm
II	4.10	2.25				
III	3.80	1.80	2.75	3.35	1.80	13.50 mm.
IV	5.05	2.10	4.15	5.55	2.30	19.15 mm.

TYPE LOCALITY.—Female holotype from Liberty County, Florida, April 12, 1935 (H. K. Wallace).

This species closely resembles *Lycosa frondicola* Emerton and *Lycosa huberti* Chamberlin in color and structure. It is distinct from these species in the characters of the epigynum.

Lycosa maasi, new species

FEMALE.—Total length, 16.50 mm.

Carapace reddish brown, with a wide median dorsal pale stripe which widens in front of the dorsal groove, passes forward and narrows between the eyes of the third row but does not extend between the eyes of the second row. Sides of the carapace darkest just laterad of the longitudinal pale band, covered with dense black pubescence at that point, lighter in color at the margins and clothed with white pubescence. Coxae and trochanters provided with a dense covering of white hairs. Eyes incompletely surrounded by black areas; the clypeus chestnut in color. Abdomen dark,

densely clothed with black and gray hairs, with a basal hastate marking which is outlined in black, the caudal half with one pair of chevrons and indistinct black markings. Third and fourth legs indistinctly annulated. Legs reddish brown above, the femora darker. Venter light gray with a yellowish cast, bounded laterally by a longitudinal black line, the epigynum with a short longitudinal black area at each side. Sternum, coxae and trochanters bright amber in color, sparsely covered with black hairs and bristles. Chelicerae black. Labium and endites darker than the coxae, the anterior margins light.

Carapace longer than broad (8.90 mm./6.50 mm.), 2.80 mm. high in front, the height of the carapace from the sternum to the highest point, 4.40 mm. Width of the face, 4.20 mm. Dorsal eye quadrangle wider than long (26/19), the anterior eyes larger than the posteriors (10/8). Anterior row of eyes slightly procurved, a line passing through the centers of the anterior median eyes cutting the upper third of the anterior laterals, distinctly shorter than the second row (18/21), the lateral eyes somewhat smaller than the medians (3/4), the medians closer to each other than to the laterals. Clypeus as high as the diameter of an anterior median eye. Chelicera, 3.90 mm. long, exclusive of the claw, 3.60 mm. wide. Lower margin of the furrow of the chelicera armed with three equally spaced teeth, the inner two equal in size and larger than the outer one; upper margin with three unequal teeth, unequally spaced, the median the largest. Labium longer than wide (1.50 mm./1.30 mm.), the basal excavations short. Sternum longer than wide (3.80 mm./3.20 mm.). Leg formula, 4123.

	FEMUR	PATELLA	TIBIA	METATARSUS	TARSUS	TOTAL
I	6.90	3.50	5.50	5.60	3.20	24.70 mm.
II	6.60	3.40	5.10	5.40	3.00	23.50 mm.
III	6.20	3.00	4.40	5.60	2.80	22.00 mm.
IV	7.80	3.20	6.20	8.70	3.50	29.40 mm.

TYPE LOCALITY.—Female holotype from Campostela, Nayarit, Mexico, April 30, 1936 (Albert E. Maas).

Lycosa iviei, new species

Figure 4

FEMALE.—Total length, 11.30 mm.

Carapace dark reddish brown in color, with a wide median longitudinal pale stripe which is slightly wider than the distance between the eyes of the posterior row. Median pale stripe somewhat constricted forward as it passes between the eyes of the third row but essentially equal in width behind to the margin, the caudal portion covered with white pubescence. Eye region thickly set with longer white hairs. Sides of the carapace dark chestnut, covered by black pubescence, with faint indications of submarginal light areas. Abdomen dark, with variegated pubescence and widely spaced black bristles, the base with a purplish hastate maculation which is bounded by light areas. Venter of the abdomen light, almost immaculate. Sternum and coxae light, amber in color, the endites and labium darker, the chelicerae chestnut. Spinnerets reddish brown. Legs dark reddish brown, with darker bands.

Carapace longer than broad (5.70 mm./4.40 mm.), 2.10 mm. high, the height

from the sternum to the top of carapace, 3.10 mm. Width of the head, 2.60 mm. Dorsal eye quadrangle broader than long (1.90 mm./1.50 mm.), the anterior eyes larger than the posteriors (8/6). First row of eyes slightly procurved (a line passing through the center of the medians cuts the upper third of the laterals), distinctly shorter than the second row (1.20 mm./1.60 mm.), the medians slightly larger than the lateral eyes, the eyes equally spaced. Clypeus approximately as high as the diameter of an anterior median eye. Chelicera, 2.30 mm. long, 2.40 mm. wide. Lower margin of the furrow of the chelicera armed with three equal teeth, the upper margin with three on the right side and two on the left in the holotype which are unequal in size. Labium as long as wide (0.90 mm.); sternum longer than wide (2.80 mm./2.30 mm.).

Leg formula, 4132, the tibiae with three pairs of ventral spines.

	FEMUR	PATELLA	TIBIA	METATARSUS	TARSUS	TOTAL
I	4.30	2.10	3.60	3.20	2.00	15.20 mm.
II	4.20	2.20	3.20	3.10	2.00	14.70 mm.
III	4.90	1.90	2.80	3.30	2.00	14.90 mm.
IV	5.10	2.00	4.10	5.30	2.50	19.00 mm.

TYPE LOCALITY.—Female holotype and paratypes from Nayarit, Mexico, June 5, 1935 (Albert E. Maas). The holotype and paratypes in the collection of The American Museum of Natural History; other paratypes in the collection of the junior author.

Lycosa oaxacana, new species

Figure 13

FEMALE.—Total length, 14.50 mm. Carapace, 6.52 mm. long, 4.75 mm. wide.

Carapace very dark reddish brown, with a median longitudinal light brown stripe which begins between the dorsal eye quadrangle, enlarges behind the posterior eyes to the width of this row of eyes, and then evenly narrows to the caudal truncature where it equals the interval between the eyes of the posterior row. Sides of the carapace uniformly dark but with a conspicuous narrow marginal white seam which is clothed with white hairs. Pale dorsal stripe clothed with white hairs, the sides with black hairs. Eyes ringed with black, the low tubercles set with white hairs. Chelicerae dark reddish brown, clothed with long black hairs. Sternum light brown, the labium and the bases of the endites somewhat darker, the clothing erect black hairs. Legs and palpi brown, the femora darker beneath, streaked above, the terminal joints of the appendages paler, clothed with black hairs. Abdomen black on the sides, the dorsum with a broad pale band which encloses a median dark maculation for most of the length and which is broken up into chevrons in the caudal half. Venter of the abdomen uniform light yellowish brown. Clothing of the abdomen black hairs, the pale dorsal stripe with pubescence of a like color.

Carapace longer than broad, moderately broad in front, the eyes of the third row two-thirds as wide as the width of the carapace at that point (20/33). Sides of the pars cephalica evenly convex. Structure of the whole carapace in essential agreement with *Lycosa frondicola* Emerton. First row of eyes narrower than the second (13/17), weakly procurved, the medians separated by one-half their diameter, as far

from the smaller lateral eyes. Clypeus equal in height to slightly more than a diameter of an anterior lateral eye. Eyes of the second row separated by five-sevenths of their diameter. Third eye row broader than the second (17/21), the eyes separated by scarcely three diameters (13/5). Dorsal eye quadrangle broader than long (21/16), narrowed in front (21/17), the anterior eyes larger. Labium slightly longer than broad (53/50). Chelicera with three subequal teeth on the lower margin. Epigynum as figured.

Leg formula, 4123, the first and second tibiae unarmed above, the third and fourth with stout basal and submedian spines. Tibiae and metatarsi with three pairs of ventral spines. Tarsi and metatarsi of the first and second legs and tarsi of the third and fourth legs scopulate beneath throughout their length.

	FEMUR	PATELLA	TIBIA	METATARSUS	TARSUS	TOTAL
I	4.80	2.30	3.85	4.10	2.50	17.55 mm.
II	4.50	2.50	3.75	4.30	2.50	17.55 mm.
III	4.20	2.15	3.25	4.65	2.30	16.55 mm.
IV	5.10	2.30	5.00	7.50	3.15	23.05 mm.

TYPE LOCALITY.—Female holotype from Palomares, Oaxaca, Mexico, July, 1909 (Dr. A. Petrunkevitch).

SCHIZOCOSA CHAMBERLIN

The genus *Schizocosa* was erected in 1904 by Dr. R. V. Chamberlin for three species of American lycosids which formed a discrete group distinguished from other members of the genus *Lycosa* by a number of important characters. The precipitous sides of the pars cephalica of the males was reminescent of *Pardosa* and had occasioned the description of some of them in this genus. There were, in addition, less important characters which often aid by their relative constancy in ascertaining the position of groups of species, such as the presence of a conspicuous brush of hairs on the anterior tibiae of the males and a rather characteristic color pattern. However, the most weighty characters were found in the genitalia. *Schizocosa* was based predominantly on the significant structure of the genitalia. The number of species belonging to the genus has been considerably increased during the last twelve years. With each addition it is becoming more and more evident that *Schizocosa*, like most of the genera of the Lycosidae, will grade gradually into *Lycosa* as this genus is used in the American sense. After careful study of the various small American species it is debatable whether *Lycosa avida* (Walckenaer) and closely related species can be withheld from *Schizocosa*. In this paper they are placed here tentatively in the belief that they deviate less far from this genus than from our other genera. A list of the species now

assigned to the genus is given below. *Arctosa incerta* Bryant seems to find its proper place in *Schizocosa*.

Schizocosa puebla Chamberlin

Schizocosa puebla CHAMBERLIN, 1925, Bull. Museum Comparative Zoölogy, LXVII, p. 231.

DISTRIBUTION.—Apparently known only from the male holotype from Albuquerque, New Mexico.

Schizocosa floridana Bryant

Schizocosa floridana BRYANT, 1934, Psyche, XLI, p. 40, Fig. 4.

FEMALE.—Total length, 7.70 mm. Carapace, 3.20 mm. long, 2.40 mm. wide.

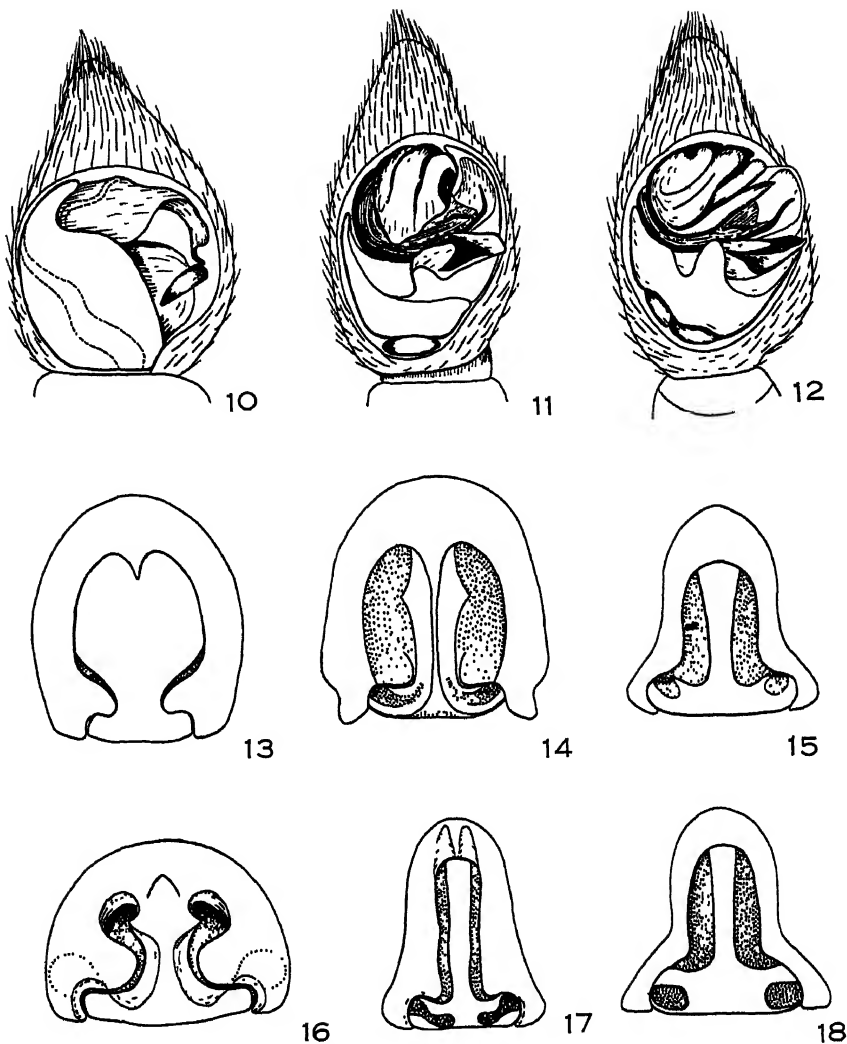
Coloration essentially as in the male. Median longitudinal pale stripe of the carapace nearly as wide as the interval between the eyes of the posterior row, extending forward between these eyes, the sides of the stripe not parallel as in *crassipes*, invaded just in front of the median groove by a tongue of dark chromatism from each side, and abruptly narrowed to half the width on the posterior declivity. Sides of the carapace dark brown, with radiating black streaks, the pale spots on the side much less conspicuous and comparatively smaller than in the male. Underside of the carapace dull yellow, the labium dusky, the maxillae dusky at base, the sternum dusky on the sides, leaving a pale median stripe. Coxae with a few black spots. Legs light brown, the basal joints mottled and annulated with black, clothed with black hairs. Abdomen as in the male, the venter heavily marked with small black spots.

Carapace longer than broad, broader in front than in the male, the sides of the head gently convex. First row of eyes slightly procurved, the medians separated by their radius, as far from the subequal laterals. Clypeus equal in height to three-fourths the diameter of an anterior median eye. Second row of eyes two-thirds as broad as the head at that point (40/62), the eyes separated by scarcely a diameter (36/30). Posterior eyes separated by three diameters (70/23). Dorsal eye quad-angle broader than long (104/84), narrowed in front in the same ratio. Labium as broad as long. Chelicera with three subequal teeth on the lower margin. Epigynum agreeing in details with *Schizocosa crassipes*.

Leg formula, 4132. Spines as in *saltatrix* or *crassipes*.

	FEMUR	PATELLA	TIBIA	METATARSUS	TARSUS	TOTAL
I	2.20	1.30	1.90	1.73	1.05	8.18 mm.
II	2.10	1.20	1.70	1.60	1.05	7.65 mm.
III	2.10	1.05	1.60	2.00	1.08	7.83 mm.
IV	2.85	1.25	2.50	3.40	1.50	11.50 mm.

RECORDS.—Levy County, Florida, April 28, 1934, females, one of which is designated as the allotype (H. K. Wallace). Escambia County, April 7, 1934, male and female (H. K. Wallace). Alachua County, March 30, 1934, males and females (H. K. Wallace).



- Fig. 10. *Arcosa paraquensis*, new species, ventral view of male palpus.
 Fig. 11. *Schizocosa segregata*, new species, ventral view of male palpus.
 Fig. 12. *Schizocosa retrorsa* (Banks), ventral view of male palpus.
 Fig. 13. *Lycosa oaxacana*, new species, epigynum of female.
 Fig. 14. *Lycosa bellamyi*, new species, epigynum of female.
 Fig. 15. *Schizocosa segregata*, new species, epigynum of female.
 Fig. 16. *Schizocosa kaeteurensis*, new species, epigynum of female.
 Fig. 17. *Schizocosa episima* (Chamberlin), epigynum of female.
 Fig. 18. *Schizocosa duplex* Chamberlin, epigynum of female.

This species differs from *Schizocosa crassipes* (Walckenaer) in its smaller size, in the irregular median band on the carapace, and in having the legs proportionately shorter.

***Schizocosa crassipes* (Walckenaer)**

Lycosa crassipes WALCKENAER, 1837, 'Insectes Aptères,' I, p. 323.

Schizocosa crassipes PETRUNKEVITCH, 1911, Bull. American Museum Nat. Hist., XXIX, p. 578.

DISTRIBUTION.—This common form is widely distributed in the United States and Canada east of the Rocky Mountains. Specimens from Austin, Texas, collected by T. H. Montgomery, are much paler than those from the eastern woods and the males lack the black brush on the first tibiae.

***Schizocosa saltatrix* (Hentz)**

Lycosa saltatrix HENTZ, 1844, Jour. Boston Soc. Nat. Hist., IV, p. 387.

Schizocosa saltatrix CHAMBERLIN, 1908, Proc. Acad. Nat. Sci. Philadelphia, p. 215, Pl. XVI, figs. 2 and 4.

DISTRIBUTION.—This species has the same range as *crassipes*. The following western records are of interest: Pikes Peak Canyon, Colorado, July 21, 1908, female (F. E. Lutz). Bear Creek Canyon, south of Boulder, Colorado, March 21, 1934, female (H. G. Rodeck). Fish Lake, Sevier County, Utah, June 22, 1930, immature female (W. J. Gertsch).

***Schizocosa duplex* Chamberlin**

Figure 18

Schizocosa duplex CHAMBERLIN, 1925, Bull. Museum Comparative Zoology LXVII, p. 231.

RECORDS.—Burlington, North Carolina, June 8, 1933, female (H. K. Wallace). Lake James, North Carolina, July 5, 1934, female (H. K. Wallace). Forestville, Maryland, June, male (Irving Fox). Halifax County, Virginia, June 17, 1935, male (W. J. Gertsch). Crossville, Tennessee, July 15, 1933, female (W. J. Gertsch). Ithaca, New York, male. Liberty County, Florida, April 10, 1935, two males, two females (H. K. Wallace).

The specimens described under this name in 1935, by Miss E. B. Bryant, belong in *Schizocosa episima* (Chamberlin)

Schizocosa episima (Chamberlin)

Figure 17

Lycosa episima CHAMBERLIN, 1924, Proc. U. S. National Museum, LXIII, p. 30, Pl. VI, fig. 46.

Schizocosa duplex BRYANT, 1935, Psyche, XLII, p. 80, Pl. v, fig. 11. (not *Schizocosa duplex* Chamberlin)

RECORDS.—Levy lake, Florida, March 14, 1934, female (H. K. Wallace). Lake Harris, Lake County, Florida, June 14, 1935, male and females (W. Ivie, H. K. Wallace and W. J. Gertsch). Escambia County, Florida, April 6, 1934, male (H. K. Wallace).

Schizocosa incerta (Bryant)

Artosa incerta BRYANT, 1934, Psyche, XLI, p. 39, Figs. 2 and 3.

RECORDS.—Alachua County, Florida, April 14, 1934, males and females (H. K. Wallace). Idem, May 8, 1934, males and females (H. K. Wallace).

Schizocosa bilineata (Emerton)

Pardosa bilineata EMERTON, 1885, Trans. Connecticut Acad. Arts and Sci., VI, p. 496, Pl. XLIX, fig. 4.

Schizocosa bilineata CHAMBERLIN, 1908, Proc. Acad. Nat. Sci. Philadelphia, p. 218, Pl. XVI, fig. 3.

RECORDS.—Woods Hole, Massachusetts, July 4, 1901, male and female (Britcher). Norwalk, Connecticut, May 27, 1933, males and females (W. J. Gertsch). Idem, June 4, 1935, females (W. J. Gertsch). Washington County, Pennsylvania, female (W. W. Long). New Lenox, Illinois, May 25, 1936, male (D. C. Lowrie). Halifax County, Virginia, June 17, 1935, female (W. J. Gertsch). Weaverville, Buncombe County, North Carolina, May 26, 1934, females (A. Carr).

Schizocosa celerior Chamberlin

Schizocosa celerior CHAMBERLIN, 1910, Ent. News Philadelphia, XXI, Pl. I, fig. 1.

RECORDS.—Tucson, Arizona, July, 1935, two females (P. Steckler). St. George, Washington County, Utah, June 12, 1934, males, females (W. Ivie).

Schizocosa crassipalpis (Emerton)

Lycosa crassipalpis EMERTON, 1909, Trans. Connecticut Acad. Arts and Sci., XIV, p. 206, Pl. VI, fig. 3.

DISTRIBUTION.—Apparently known only from Massachusetts and Maine.

Schizocosa avida (Walckenaer)

Lycosa avida WALCKENAE, 1836, 'Insectes Aptères,' I, p. 322.

DISTRIBUTION.—This is one of the commonest American lycosids and is found throughout the United States, in Canada, and in northern Mexico.

Schizocosa segregata, new species

Figures 11 and 15

MALE.—Total length, 4.60 mm. Carapace, 2.60 mm. long, 1.90 mm. wide.

Carapace with a median longitudinal yellow band which begins between the dorsal eye quadrangle, is invaded by the dark rings of the eyes of the posterior row and then continues caudad to the margins. Sides of the dorsal pale stripe nearly parallel, slightly narrowed on the posterior declivity, the width in front equal to the interval between the posterior eyes. Clothing of the dorsal stripe pale hairs and a few erect black bristles. Sides of the carapace dark brown to black, with a submarginal pale band which is made up of four discrete pale spots and with a marginal black band. Clothing of the sides fine black hairs but with pale ones on the submarginal band of spots. Eyes ringed with black, the dorsal quadrangle with long gray hairs. Labium dusky, the endites pale yellow, the sternum pale yellow, with a black smudge opposite each coxa, the clothing of fine erect black hairs sparse. Legs pale yellowish brown but the basal joints thickly mottled or ringed with brown, the distal joints pale. First tibiae black, clothed with a thin brush of coarse black hairs. Abdomen black or dark brown on the sides, the dorsum with a broad paler stripe of reddish color which encloses black spots. Venter of the abdomen pale yellowish brown, with a few small dark spots.

Carapace longer than broad, narrowed in front, the sides of the head precipitous, the width of the head at the first eye row, 0.92 mm. First row of eyes moderately procurved, the medians separated by a radius from the slightly smaller lateral eyes and quite as far from each other. Eyes of the second row large, separated by scarcely their diameter (37/30), the row occupying the width of the head. Eyes of the posterior row separated by twice their diameter. Dorsal quadrangle broader than long (97/88), narrowed in front in the same ratio, the anterior eyes larger (37/29). Clypeus equal in height to a radius of the anterior lateral eye. Chelicera with three subequal teeth on the lower margin. Labium as long as broad.

Leg formula, 4123. Spines as usual in the genus.

	FEMUR	PATELLA	TIBIA	METATARSUS	TARSUS	TOTAL
I	1.97	1.05	1.65	1.73	1.04	7.44 mm.
II	1.85	0.95	1.43	1.65	1.00	6.88 mm.
III	1.80	0.82	1.30	1.77	0.95	6.64 mm.
IV	2.35	0.95	2.06	2.75	1.15	9.26 mm.

Palpus as in figure 11, the median apophysis agreeing in detail with that of *Schizocosa duplex* Chamberlin but the distinct horn present in the distal division of the bulb in that species lacking in *segregata*. Embolus much shorter than in *Schizocosa saltatrix* (Hentz).

FEMALE.—Total length, 7.70 mm. long, 3.20 mm. long, 2.40 mm. wide.

Coloration as in the male. Median longitudinal pale stripe of the carapace nearly as wide as the interval between the eyes of the posterior row, extending forward between the eyes and narrowed somewhat behind on the posterior declivity. Legs moderately long but the first tibiae lacking the brush of black hairs present in the male. Structure essentially as in the male but the sides of the pars cephalica less precipitous. Epigynum as in figure 15, structurally very near that of *avida*.

TYPE LOCALITY.—Male holotype, female allotype and male and female paratypes from Levy County, Florida, taken April 28, 1934 by H. K. Wallace.

Schizocosa retrorsa (Banks)

Figure 12

Pardosa retrorsa BANKS, 1911, Proc. Acad. Nat. Sci. Philadelphia, p. 453, Pl. XXXIV, figs. 3 and 6.

MALE.—Total length, 6.40 mm. Carapace, 3.20 mm. long, 2.25 mm. wide.

Carapace dark brown, with a median longitudinal yellow band which extends narrowly forward between the eyes of the first row, is somewhat enlarged just behind the posterior eye row and then continues caudad to the margin, the width of the caudal portion of the band half the interval between the posterior eyes. Sides of the carapace with a submarginal pale band made up of four light spots. Clothing of the carapace black and white hairs. Sides of the carapace covered chiefly with black hairs. Sternum pale yellowish brown, clothed with white hairs, the labium concolorous. Coxae and endites dull yellow, set with erect black hairs. Legs dusky brown, paler distally, the first tibiae clothed with black hairs which form a distinct brush, the hairs thickest on the ventral surface, the other joints of the first and other legs clothed with black hairs. Femora faintly annulated in black. Abdomen black on the sides, the dorsum with a pale brown longitudinal stripe the whole length which encloses a darker basal hastate maculation, the venter pale.

Carapace longer than broad, relatively narrow in front, the sides of the head declining abruptly. Width of the head at the second eye row, 1.40 mm. Pars cephalica slightly higher than the pars thoracica, the carapace essentially equal in height caudad to the longitudinal median groove. First row of eyes weakly procurved, the median separated by three-fourths their diameter, three-fifths their diameter from the subequal lateral eyes. Clypeus equal in height to scarcely a diameter of the anterior median eyes. Second row of eyes broader than the first (88/64), the eyes separated by their diameter. Eyes of the posterior row separated by scarcely three diameters. Dorsal eye quadrangle broader than long (103/86), narrowed in front (130/88), the anterior eyes larger. Chelicera with three subequal teeth on the lower margin of the furrow. Labium as broad as long.

Leg formula, 4123. Spines as usual in the genus. Palpus as figured.

	FEMUR	PATELLA	TIBIA	METATARSUS	TARSUS	TOTAL
I	2.60	1.20	2.00	2.13	1.40	9.33 mm.
II	2.25	1.10	1.75	1.95	1.32	8.37 mm.
III	2.25	0.97	1.60	2.10	1.27	8.19 mm.
IV	3.10	1.10	2.50	3.47	1.75	11.92 mm.

DISTRIBUTION.—Illinois. Georgia. North Carolina. Tennessee. Virginia. Pennsylvania.

The male described above, from Waukegan Flats, Illinois, taken August 26, 1936, by Mr. D. C. Lowrie, has the first tibiae provided with a brush of black hairs. In examples from North Carolina the amount of pubescence is much less, usually no more conspicuous than in *avida*.

Schizocosa minnesotensis (Gertsch)

Lycosa minnesotensis GERTSCH, 1934, American Museum Novitates, No. 726, p. 4, Fig. 2.

DISTRIBUTION.—Minnesota. Alberta. Idaho.

Schizocosa kaieteurensis, new species

Figure 16

FEMALE.—Total length, 5.50 mm.

Carapace brown on the sides, with an irregular submarginal pale stripe on each side and a marginal black seam, the dorsum with a broad median longitudinal pale yellow stripe which begins between the eyes of the dorsal quadrangle, continues caudad half the distance to the median groove, is somewhat narrowed at that point, and then narrows back to the caudal margin. Eyes broadly ringed with black. Clothing of the carapace fine black hairs, the pale areas and the dorsal ocular quadrangle with white hairs. Chelicerae dark brown. Sternum and coxae pale yellow, the endites and labium dusky, all clothed with erect black hairs. Legs light yellowish brown, the distal joints paler, the femora and tibiae with dark annulae. Abdomen dusky on the sides, pale above, the venter pale yellow.

Carapace longer than broad (2.95 mm./2.03 mm.), rather broad in front, the width of the head at the second eye row, 1.40 mm. Sides of the pars cephalica rather steeply declining, essentially as in *Schizocosa tristani* (Banks). Eyes of the anterior row narrower than the second (55/95), procurved, the medians separated by scarcely a diameter, a little nearer the smaller lateral eyes. Eyes of the second row separated by three-fourths their diameter. Eyes of the posterior row eleven-fourteenths as wide as the carapace at that point (115/140), separated by two and one-third times their diameter (3/7). Dorsal eye quadrangle broader than long (115/90), narrowed in front in about the same ratio, the anterior eyes larger. Clypeus equal in height to the diameter of an anterior median eye. Chelicera with three subequal teeth on the lower margin. Labium as broad as long.

Leg formula, 4132. Spines long, all the tibiae and metatarsi with three pairs on the ventral surface. First two tibiae without dorsal spines, the last two with a basal and a submedian spine.

	FEMUR	PATELLA	TIBIA	METATARSUS	TARSUS	TOTAL
I	2.15	1.00	1.80	1.60	1.13	7.68 mm.
II	1.90	0.94	1.60	1.58	1.05	7.07 mm.
III	1.98	0.87	1.48	1.90	1.10	7.33 mm.
IV	2.60	1.05	2.35	2.95	1.35	10.30 mm.

TYPE LOCALITY.—Female holotype from Kaieteur, British Guiana, August 8, 1911 (F. E. Lutz).

This spider closely resembles *Schizocosa tristani* (Banks) and the epigynum is suggestive of that species. It is, however, considerably smaller and less strongly marked with black, the sternum completely lacking a conspicuous central maculation as in *tristani*.

Schizocosa tristani (Banks)

Lycosa tristani BANKS, 1909, Proc. Acad. Nat. Sci. Philadelphia, p. 218, Pl. v, fig. 4, Pl. vi, fig. 42.

Pardosa albopilosa PETRUNKEVITCH, 1925, Trans. Connecticut Acad. Arts and Sci., XXVII, p. 174, fig. 93

Schizogyna tristani BANKS, 1929, Bull. Museum Comparative Zoology, LXIX, p. 83

RECORDS.—Turrialba, Costa Rica (Tristan) (Banks, 1909), type locality of *Lycosa tristani* Banks. Panama City, Panama (Petrunkévitch, 1925), type locality of *Pardosa albopilosa* Petrunkevitch. Barro Colorado Island, Canal Zone (Banks, 1929). Idem, numerous males and females taken near the lake shore with the aid of a head lamp in February and March, 1936 (Gertsch). Macato, Venezuela, one male. Paramaribo, Dutch Guiana, one male. British Guiana, male and female (Leo E. Miller). Potaro Lodge. British Guiana, August 18, 1911, male and female (F. E. Lutz).

DESCRIPTION OF A NEW SPECIES OF *SYMPHYLURINUS*
(INSECTA, DICILLURA) FROM CENTRAL AMERICA

BY FILIPPO SILVESTRI

In a collection of terrestrial small Arthropoda (called by me "*micro-genion*") made in 1930 by Dr. Frank E. Lutz at Barro Colorado (Panama), I have found a specimen of *Symphylurinus* which is very peculiar especially in the structure of the apical setae of the subcoxal appendices of the first urosternum and which is being described here as a new species. I note that *Symphylurinus* has a number of representatives in South America and a few in Africa and Asia.

Symphylurinus lutzii, new species

Figures 1 to 3

Corpus cremeum, caput supra setis brevibus integris parce numerosis et nonnullis minus brevibus, postantennalibus duabus μ 78 longis subintegris, setis et sensillis consuetis vido figure 2, A, palpo labiali fere $\frac{3}{4}$ longiore quam latiore.

Thorax.—Pronotum macrochaetis 4 + 4 sat longis (lateralibus μ 100 longis), barbulis 2-3 instructis, superficie cetera setis paucioribus brevibus et brevioribus; mesonotum macrochaetis 2 + 2 subanticis, macrochaetis 2 + 2 transverse submedianis, macrochaeta laterali subpostica et macrochaetis 3 + 3 posticis barbulis 1-2 auctis, postica laterali μ 130 longa, cetera superficie setis paucioribus brevioribus et brevibus; metanotum macrochaetis 1 + 1 et 3 + 3 posticis, cetero mesonoto simile.

Sterna praesternis, acetabuli margine antico et furcosterno setis duabus anticis, duabus inter pedes et duabus posticis parum longis et barbulatis, setis ceteris brevioribus et brevibus et integris.

Pedes sat setosi, primi parvis tibiis apicis strigile setis spatuliformibus 4, parvis tertiis trochantero macrochaetis inferis brevibus barbulatis duabus, femore macrochaetis superis 4 parum longis et inferis submediana et duabus apicalibus, tibia macrochaeta ventrali brevi praemediana, calcaribus apicalibus simplicibus, tarso setis brevioribus magis numerosis et setis duabus superis distalibus quam ceterae aliquantum longioribus, praetarsi unguibus modice arcuatis, ungue postico quam antiquo fere $\frac{1}{3}$ longiore.

Abdomen.—Tergitum 1^{um} macrochaetis 1 + 1 subanticis submedianis et 1 + 1 posticis submedianis, 2^{um} 1 + 1 subanticis et 2 + 2 posticis, 3^{um} 1 + 1 subanticis et 3 + 3 posticis, tergite 4^{um} ad 7^{um} macrochaetis anticis 3 + 3, laterali utrimque singula et posticis 4 + 4, omnibus barbulis 3-5 et lateralibus posticis μ 120 longis, ceteris quam dictae parum brevioribus, tergite 8^{um} macrochaetis posticis 4 + 4, 9^{um} 3 + 3, 10^{um} macrochaeta subpostica mediana sat longa quam setae submedianae marginales fere $\frac{3}{8}$ longiore, setis marginalibus ceteris quam submedianae parum brevioribus.

Urosternum primum macrochaetis 7 + 7, quarum 3 + 3 subanticae, sat longis et barbulis nonnullis auctis, appendicibus subcoxalibus elongatis subcylindricis, quum stili $\frac{1}{3}$ longioribus et setis duabus posticis longis clavatis instructis, stilis subconicis, μ 65 longis setis integris instructis; urosterna 2-7 macrochaetis 6 + 6, quarum 2 + 2 anticae, stilis elongatis; urosternum 8^{um} macrochaetis posticis 1 + 1, 9^{um} macrochaetis 2 + 2, 10^{um} macrochaetis submedianis subposticis et submediani-sublateralibus posticis longis, robustis subaequalibus.

Cerci 11-articulati articulo secundo a primo subindistincto, tertio a quarto parum magis distincto, ceteris distinctis, setis vide figure 3, G.

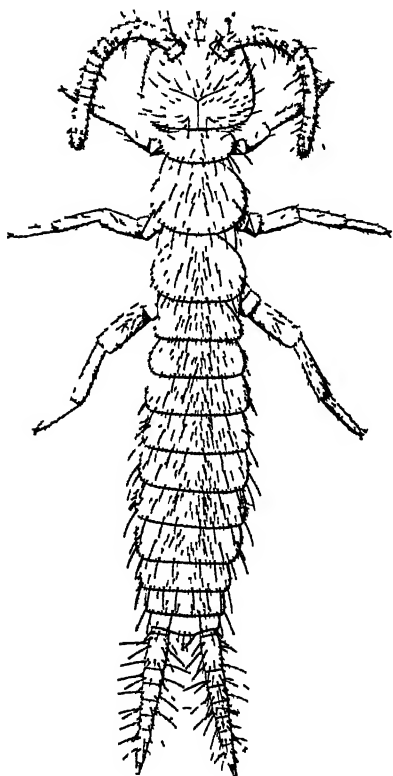


Fig. 1

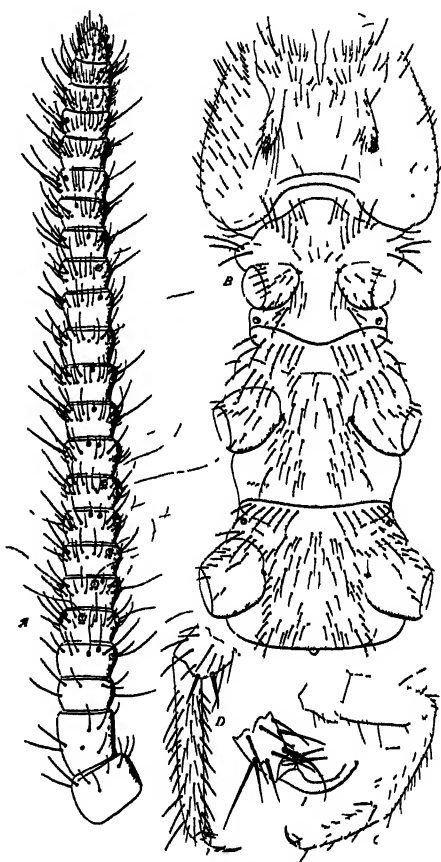


Fig. 2

Fig. 1. *Symphylurinus lutzi*: animalculum pronum (ampliatum).

Fig. 2. A, Antenna dextera prona; B, caput et thorax supina; C, pes parvis tertii; D, eiusdem tibiae apex, tarsus et praetarsus magis ampliat; E, tarsi apex et praetarsus multo ampliat.

Long. corporis mm. 2, lat. capitis 0.39, long. antenn. 0.65, long. pedum paris tertii 0.90, cercorum 0.58.

Habitat.—Exemplum descriptum ad Barro Colorado (Panama) clar. Dr. Frank E. Lutz, cui species dicata est, legit.

Observatio.—Species haec ad *S. grassii* Silvestri proxima sed macrochaetis dorsualibus aliquantum longioribus, parum magis barbulatoris, urosterni primi processibus subcoxalibus longioribus et *setis duabus posticis longis clavatis* instructis et urotergiti decimi macrochaeta mediana quam submedianae fere $\frac{3}{8}$ longiore saltem distinguenda est; cum mares adulti noti sint, characteres ceteri inquirendi sunt.

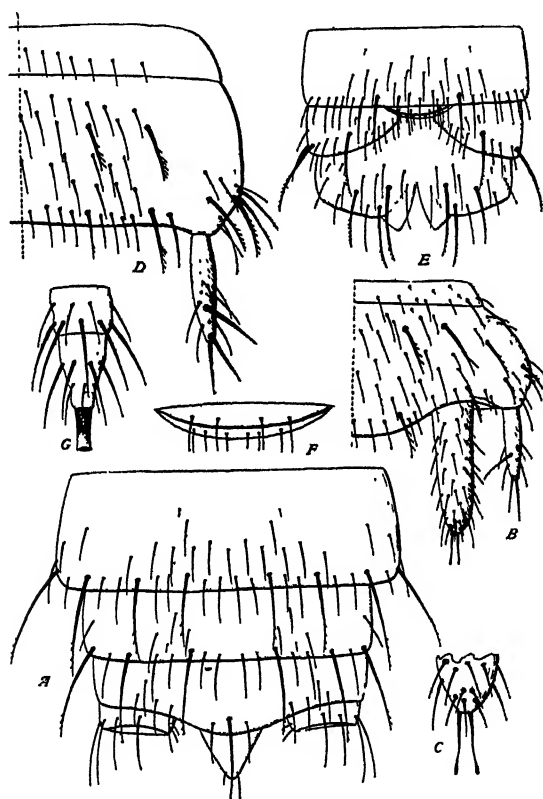


Fig. 3. A, Abdominis pars postica prona; B, urosterni primi dimidia pars; C, eiusdem urosterni appendicis subcoxalis apex magis ampliatus; D, urosterni quinti dimidia pars; E, abdominis pars postica supina; F, laminae supra et infra aperturæ genitalis; G, cerci apex.

AMERICAN MUSEUM NOVITATES

Number 921

Published by
THE AMERICAN MUSEUM OF NATURAL HISTORY
New York City

May 3, 1937

TWO NEW HARVEST MICE FROM HONDURAS

By GEORGE G. GOODWIN

This is the second preliminary report on the mammals recently collected by C. F. Underwood in Honduras and Costa Rica. In the collections there is a large series of several species of harvest mice, and two from Ocotepeque represent hitherto undescribed forms.

My thanks are due to the U. S. Biological Survey for the loan of comparative material and to Mr. A. H. Howell for comparing these specimens with the large series in Washington and commenting upon their relationships.

Reithrodontomys mexicanus ocotepequensis, new subspecies

Ocotepeque Harvest Mouse

TYPE.—No. 124860, Amer. Mus. Nat. Hist.; male adult; Monte Verde, Department of Ocotepeque, Honduras, 30 miles northeast of the city Ocotepeque; altitude 4500 feet; July 23, 1936; collector, C. F. Underwood. The type is a skin and skull in good condition.

GENERAL CHARACTERS.—Similar to *Reithrodontomys mexicanus lucifrons*, but color of pelage slightly darker, tail shorter and skull distinctly smaller.

DESCRIPTION.—Upper parts, from crown to rump, dark sayal brown varied with fuscous; forehead to sides of face dark cinnamon-buff; eye-ring black; sides of body near clay color, very little paler than back; ears fuscous; feet dull white, hind feet with median stripe of hair-brown reaching to base of toes; under parts soiled whitish, broadly plumbeous basally; tail fuscous, unicolor.

SKULL.—Small and slender with rostrum rather narrow for the *mexicanus* group; nasals slender, ending posteriorly on a line with ends of premaxillae; braincase small and rounded; palatal foramen short, ending in front of plane of first molars: similar to *R. m. lucifrons*, but distinctly smaller, with smaller teeth, less inflated braincase and relatively narrower rostrum.

MEASUREMENTS OF TYPE SPECIMEN.—Skin, measured in the field, head and body, 80 millimeters, (female topotype 80); tail vertebrae, 101 (105); hind foot, 15, in dried skin, 19.6 (18.5); ear, in dried skin, 13 (14). Skull, greatest length, 23.8 (22.8); width of braincase, 10.9 (10.8); length of nasals, 8.4 (8); interorbital constriction, 3.5 (3.5); width of outer wall of antorbital foramen, 1.4 (1.5); alveolar length of upper molar series, 3.15 (3.1).

The twelve specimens on which this race is based agree closely in color and cranial characters. The type, which is an adult male with worn molars, represents near the maximum rather than the medium

size of *R. m. ocotepequensis*. The skulls in the topotypes, while more or less adult, are slightly smaller with somewhat more globular braincases than in the type. *R. m. ocotepequensis* is quite unlike *R. m. mexicanus*, which is much larger, and needs comparison only with *R. m. lucifrons*. From the latter it differs in darker color, shorter tail, smaller and more slender skull.

***Reithrodontomys dorsalis underwoodi*, new subspecies**

Underwood Harvest Mouse

TYPE.—No. 124869, Amer. Mus. Nat. Hist.; adult (sex not noted); Monte Verde, Department of Ocotepeque, Honduras; altitude 4500 feet; July 24, 1936; collector, C. F. Underwood. The type is a skin and skull in good condition.

GENERAL CHARACTERS.—A small, dark-colored harvest mouse, with relatively short tail, small ears and buffy under parts; similar to typical *R. dorsalis*, but differs in having nearly unicolor tail, richer color and slightly smaller skull.

DESCRIPTION.—Upper parts, from crown to rump, ochraceous-tawny mixed with black, with a broad, dark, dorsal area; sides of body and head ochraceous-tawny lightly varied with fuscous, clearer on cheeks and along lateral line next to belly; under parts washed with light buff; an ochraceous-buff area in pectoral region; ears fuscous-black; hind feet soiled whitish; forefeet white with a dusky stripe reaching half way to toes; tail fuscous, nearly unicolor, only slightly paler below.

SKULL.—Small and rounded; palatine foramen extending posteriorly to just beyond the plane of first molars, similar to *R. dorsalis*, but slightly smaller.

MEASUREMENTS.—Head and body, 73 millimeters; tail vertebrae, 90; hind foot, 19; ear, 17. Skull, greatest length, 23; breadth of braincase, 10.5; length of nasals, 9.4; width of outer wall of antorbital foramen, 1.9; interorbital constriction, 3.2; alveolar length of upper molar series, 3.1.

This race is based on four specimens, which agree closely in color and size. In the type the tail is practically unicolor, while in the other three specimens it is slightly paler below, but the line of demarcation is indistinct. The skull of one specimen, however, is much smaller than any of the other three. *R. d. underwoodi*, compared with typical *R. dorsalis*, is somewhat similar in size and color, but differs in richer color. The upper parts and sides of body in *R. d. underwoodi* are ochraceous-tawny. In *R. dorsalis* these parts are ochraceous-buff. The tail in *R. d. underwoodi* is nearly unicolor. In *R. dorsalis* the under side of the tail is white, with the line of demarcation sharply defined.

AMERICAN MUSEUM NOVITATES

Number 922

Published by
THE AMERICAN MUSEUM OF NATURAL HISTORY
New York City

May 4, 1937

RESULTS OF THE ARCHBOLD EXPEDITIONS. No. 15¹

A NEW FISH OF THE GENUS *BOSTRYCHUS* FROM NEW GUINEA

By J. T. NICHOLS

In a small collection of fresh-water fishes brought to The American Museum of Natural History by the 1936 New Guinea Expedition led by Mr. Richard Archbold, there is a goby of the genus *Bostrychus* with a distinctive color pattern, which is apparently more like *Bostrychus sinensis* Lacépède than *B. zonatus* Weber described from there in 1907. I believe it represents an undescribed species, which I will call *Bostrychus strigogenys* from the conspicuous dark stripes on the white lower part of the face behind the eye.

Bostrychus strigogenys, new species

DESCRIPTION OF TYPE.—No. 13652, American Museum of Natural History, from the Upper Fly River, Papua, W. D., 5 miles below Palmer Junction, collected in the latter part of May, 1936, by R. Archbold, A. L. Rand and G. H. H. Tate.

Length to base of caudal, 135 mm. Depth in this length, 6.5; head, 3.7. Eye in head, 7; snout, 3.8; interorbital, 2.8; maxillary, 2.2; width of head, 1.4; pectoral 2; ventral, 2.1; longest ray of first dorsal, 5; of second dorsal, 3; of anal, 3; caudal, 1.5; distance between dorsals, 4.

Dorsal rays, VI—12; anal, 11. Scales, about 120.

Head broad, depressed in front, the body cylindrical in front, compressed behind. Jaws equal, the mouth only slightly oblique, the maxillary to beyond the posterior margin of eye; anterior nostril in a tube, remote from the posterior and adjacent to the upper jaw; eye well forward, slightly superolateral; interorbital space broad, slightly concave; gill membranes meeting under the middle of, and joined within to the isthmus under the posterior end of the preopercle; teeth in broad bands on jaws, in a broad triangle with corners produced somewhat backward, on vomer. Pectorals and caudal rounded; first dorsal low, well separated from the second, its rays weak. Scales smooth and irregular, becoming small and imbedded on breast and head.

Dark above and on upper two thirds of side; contrastingly white below from breast to peduncle and on lower part of cheek and opercles; dark meeting white on the sides in a very irregular line, with an upward streak of white on one side of the peduncle, a spot on the other; three dark stripes slant downward and backward across the face, the middle one from below the eye, the lowest from the maxillary, the upper two boldly contrasted against the white background; lower jaw across branchio-

¹ This is the second ichthyological paper based on material collected by Archbold Expeditions to New Guinea. American Museum Novitates No. 755, Nichols and Raven, November 17, 1934, antedates establishment of the series numbers in 1935.

stegals gray. Fins all dark, the ventrals bordered with pale, and the vertical fins with slight pale edges, a black area on the upper caudal base bordered in front by a semicircle of pale to form an imperfect ocellus, and a pale mark on the lower caudal base below this; 2 or 3 faint vertical rows of pale spots across caudal.

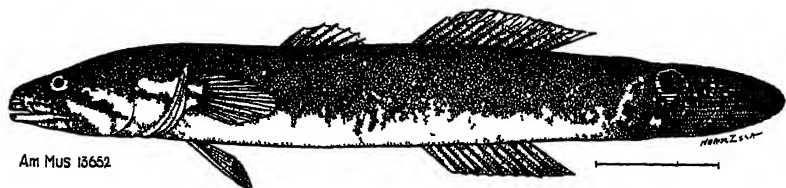


Fig 1.—*Bostrychus strigogenys*, type

There are 5 paratypes measuring from 45 mm. to 162 mm. in standard length. All of them show dark and white striping across the lower face somewhat in this pattern though in no two alike. In the smallest the white stripes are narrow; in the largest they are of about equal width with the dark, the uppermost dark stripe and a white stripe above it extending obliquely onto the base of the pectoral; a third specimen has merely a few white marks imperfectly delimiting the dark stripe areas, and this is also least white below; and in another specimen the central dark stripe only is present in a large white field, and imperfect on one side of the fish. All have an imperfect caudal ocellus variously indicated.

In these paratypes the dorsal rays vary from VI—12 to VI—14, anal from 10 to 11; scales from about 120 to 130; depth of body in length from 5.8 to 7; head from 3.4 to 3.8; interorbital in head from 2.8 to 2.9. The eye measurement in head, alone shows a progressive change with the size of fish, 5 at 45 mm., 6.3 at 98 mm., 7 at 113 mm., 7.5 at 144 mm., and 8 at 162 mm.

AMERICAN MUSEUM NOVITATES

Number 923

Published by
THE AMERICAN MUSEUM OF NATURAL HISTORY
New York City

May 4, 1937

TWO NEW TACHINIDAE (DIPTERA)

PARASITIC ON *POLYBIA* SPECIES (HYMENOPTERA)

By C. H. CURRAN

Through the courtesy of Mr. O. W. Richards of the Imperial College of Science and Technology, London, I have received for study two species of flies that are undoubtedly true parasites of two species of *Polybia*. Dipterous parasites of wasps are not known to be numerous and these are, I think, the first records from America. The flies of the family Metopiidae are not, so far as known, parasitic on the larvae of wasps and bees, but feed upon the food stored by the hymenopterous insects for the purpose of nourishing their young. In this latter case it is probable that the majority of the larvae of the bees and wasps die from hunger because these insects lay eggs, while the flies deposit living maggots and their offspring are well grown before the eggs of the hymenoptera hatch.

We are indebted to Mr. Richards for the privilege of retaining the types. Paratypes of both species have been returned to him and will be deposited in the British Museum of Natural History.

Telothyriosoma polybia, new species

Agrees with Townsend's description of *T. tersa* with the following exceptions: the antennae are blackish with the basal segments more or less reddish, there is a single pair of bristles below the base of the antennae, the abdominal pollen is whitish and the wing veins are broadly bordered with brown. Length, 8 to 10 mm.

MALE.—Front about one-fourth as wide as one eye, slightly widening anteriorly, the frontal vitta brown, almost linear above, the parafrontals brassy yellow; frontals all more or less reclinate, the second and third pair from the vertex long and strong; a few hairs on the parafrontals; ocellars absent. Occiput yellowish pollinose on the upper half, white below, the pile pale yellowish; a single row of black occipital cilia. Cheeks about one-eighth the eye-height, with short, sparse black hair on the lower half. Face and cheeks white pollinose, the parafacials very narrow; three to five short bristles on the ridges above the vibrissae. Palpi reddish, slightly enlarged apically. Antennae blackish with the basal two segments more or less reddish; arista short pubescent. Eye with short, rather sparse hair.

Thorax black in ground color, thickly pollinose, the dorsum brassy yellow, the pleura mostly cinereous; mesonotum with four narrow black vittae; hair all

black. Acrosticals 3-2; dorsocentrals 3-2; posterior sublateral present; three pairs of marginal scutellars, the median pair weak; two sternopleurals; propleura bare, infrascapular setulae absent; prosternum with pair of bristles and one or two pairs of hairs.

Legs blackish, the apices of the femora and the tibiae brownish red. Anterior tibiae with a single posterior bristle; middle tibiae with one antero-dorsal bristle; posterior tibiae with two posterodorsal and three anterodorsal bristles; claws and pulvilli long.

Wings cinereous hyaline, the veins broadly bordered with brown except on the basal fifth of the wing. Third vein with two or three bristles above and below at the base, apical cell narrowly open a little before the wing-tip.

Abdomen a little more than twice as long as wide, reddish yellow, a narrow median vitta, the apical half of the third and the whole of the fourth segment black. Second and third segments with narrow basal bands of thin white pollen, the fourth segment white pollinose with a dorsal triangle extending from the apex to the base; under side of third segment white pollinose. On the venter there is a narrow black line extending along the middle from near the base to the middle of the third segment; sternites concealed except at the base and apex of the abdomen. Genitalia blackish, mostly concealed. First and second segments with median marginals, the third and fourth with row. No discs.

FEMALE.—Front almost half as wide as one eye, the frontal vitta somewhat wider and of more uniform width; four pairs of frontals and two pairs of proclinate orbitals; parafrontals white pollinose on the outer half; outer verticals half as long as verticals but weak. Claws and pulvilli shorter. Abdomen black except on the sides of the venter basally; pollen cinereous and much more extensive, leaving black apical bands on the apices of the second and third tergites and the sides of the first segment beneath, shining. In this sex the abdomen is shorter and less pointed and there are two posterior bristles on the anterior tibiae.

TYPES.—Holotype, male, allotype, female, and paratypes, three males and four females, Trinidad, Marine Club, December, 1934 (D. Vesey Fitzgerald) reared from larvae in nest of *Polybia rejecta* Fabricius. Pupation took place in the cells of the wasp nest. Emergence of the adults occurred between December 7 and 10.

POLYBIOPHILA, NEW GENUS

Differs from *Tachinophyto* Townsend by the absence of orbitals in the male, the absence of bristles on the lower fourth of the facial ridges and more elongate abdomen. Differs from *Lixophaga* Townsend by having only two pairs of preapical dorsocentrals.

Front of male three-fifths as wide as one eye; frontal vitta slightly narrower than parafrontal; nine pairs of frontals, the upper three reclinate; ocellars short and fine; outer verticals absent; cheeks one-sixth eye-height; face moderately retreating, the oral margin slightly produced; vibrissae level with oral margin, the ridges with two or three bristly hairs immediately above the vibrissae; middle of face moderately depressed and weakly carinate. Proboscis short; palpi clavate. Antennae arising slightly below the middle of the eyes; reaching the lowest sixth of the face; third segment slightly more than three times as long as the second, moderately narrow; arista thickened on the basal fourth and microscopically pubescent.

Acrosticals 3-3; dorsocentrals, 2-3; three intra-alars; posterior sublateral short and fine; pre-alar one-third as long as the following bristle; three pairs of marginal scutellars and usually a pair of apical hairs; one pair of discal scutellars; two sternopleurals; propleura bare; infrascapular setulae absent; prosternum with a pair of bristly hairs.

Anterior tibiae with a single posterior bristle, the middle one with one antero-dorsal; posterior tibiae with a strong antero-dorsal and posterodorsal beyond the middle and three weak bristles on the basal half of these surfaces; claws and pulvilli elongate.

Wings, cinereous hyaline; apical cell narrowly open a little before the wing-tip; third vein with two or three bristles basally. Squamae large.

Abdomen more than twice as long as wide, tapering on the posterior half; genital opening sub-triangular; first sternite with erect hair. First and second segments with median marginals, the third and fourth with row; second and third segments each with pair of discals, the fourth with one or two pairs on the apical third and several weak ones.

GENOTYPE.—*P. fitzgeraldi*, new species.

The genotype is parasitic on *Polybia* species.

Polybiophila fitzgeraldi, new species

Black with brassy yellowish pollen. Length, 5.5 to 6 mm.

MALE.—Head with brassy yellow pollen, the lower half of the occiput whitish. Parafrontals with scattered short black hairs; occipital pile pale yellow; cheeks with black hair over most of their area. Palpi reddish. Antennae black or brown.

Pollen on lower part of pleura cinereous; four mesonotal vittae, the outer pair broad and only obscurely interrupted at the suture, the inner pair narrow in front of the suture, greatly broadened behind, but not fused; scutellum brownish on almost the basal half.

Legs black, the trochanters more or less reddish; pulvilli grayish.

Wings cinereous hyaline. Squamae brownish yellow; halteres yellow.

Abdomen with the under surface more than half reddish, the pale color extending somewhat onto the dorsum of the first segment and forming large basal triangles on the second and third; second segment pale pollinose on the basal half in the middle, the pollen expanding to beyond the middle toward the sides. Pale pollinose fascia on the third segment occupying the basal two-fifths and of almost uniform width, that on the fourth occupying the basal half in the middle and strongly expanding to the apical fourth laterally. The pollen is obscure on the venter except on the fourth segment.

FEMALE.—Front about as wide as in male but with two orbitals on each side. Pollen on second and third abdominal segments not narrowed in the middle but more or less expanded at this point. Claws and pulvilli short.

Types.—Holotype, male, allotype, female, and two male paratypes, Mt. St. Benedict, Trinidad, April 5, 1933 (D. Vesey Fitzgerald).

The note accompanying the flies is as follows: "A number of fly larvae (very active) tumbled out of a nest of the wasp *Polybia occidentalis* (Olivier) [det. Bequaert] and wriggled about in a great hurry; ap-

parently they were ready to pupate. One was observed to emerge from a silken covered cell, in which was found the flabby remains of a wasp grub. The larvae readily burrowed into sand. April 6, 1933, several puparia found. April 19, 1933, adults emerging."

AMERICAN MUSEUM NOVITATES

Number 924

Published by
THE AMERICAN MUSEUM OF NATURAL HISTORY
New York City

May 4, 1937

THREE NEW SPECIES OF *TYTTHONYX* FROM CUBA

BY ANDREW J. MUTCHLER

The first records of the genus *Tytthonyx* from the West Indies were published by Mr. C. W. Leng and the present author (1922, Bull. Amer. Mus. Nat. Hist., XLVI, pp. 489-490). They included two species from Puerto Rico and one from Cuba. Later (1923, Amer. Mus. Novitates, No. 63, pp. 8-9), the present author described a species from Antigua. A fifth species was described (Pan Pacific Entomologist, 1934, pp. 30-32) by Howard E. Hinton.

The three forms herein described were collected by Dr. P. J. Darlington of the Museum of Comparative Zoölogy and sent to the American Museum for determination. They are unlike any of the previously described species, being mostly red or yellowish red in color with the black underwings protruding from beneath the short elytra.

The red color is similar to that of some of the species of *Thonalmus*. Two of the species have the elytra unicolorous red but the other has the basal parts red and the tips black. In all three of these species the protruding underwings are black. This combination of colors, at a casual glance, makes these forms appear as though related to the genus *Thonalmus*.

The color of these species will suffice to separate them from the other described West Indian forms. The males of the three forms herein described may be readily separated by the shape of the emargination of the apical ventral segments of the abdomen. In only one of these the oedagus is visible in the emargination.

The drawings illustrating these forms were made by Mr. Pierre Noël, who has allowed to some extent for distortions which are likely to occur in the bodies of insects which are as soft as the Cantharidae. A good light and a somewhat high magnification are necessary to bring out some of the characters mentioned in the following descriptions. The binocular microscope magnifications used in making the following descriptions were 12.5 × oculars and a 6.8 × objective.

Tytthonyx rutilis, new species

Figures 1 and 2

Elongate. Yellowish red. Antennae (excepting basal joint), underwings, palpi, apex of femur, tibiae and tarsi, black. Apical abdominal segments of female black, of male dusky. Head finely punctulate and sparsely covered with short pale pubescence; antennae compressed somewhat strongly serrate from third joint; first joint somewhat club-shaped, color above dark brown to black, beneath yellowish red, about one-third longer than second, second and third nearly equal in length; eleventh elongate, somewhat pointed, surface somewhat granulate and with short hairs. Pronotum with margins raised, front angles broadly rounded, hind angles less broadly rounded; disk with median impressed longitudinal line, surface finely punctate and sparsely covered with very short, pale pubescence. Elytra about two and one-half times longer than the thorax, slightly narrowing from about apical third, apical angles broadly rounded in female, less so in male, surface coarsely punctate and costate, a short costa beginning just below apex of the scutellum and extending to about middle of elytra, another more prominent oblique costa beginning at the humerus and extending to near apex of elytra; there is another costa beginning at the side behind the humeri and extending back obliquely to near the apex. There are also other short oblique raised lines on the disk which can be seen under high power. The disk is sparsely covered with very short pale pubescence which becomes more dense along the margins. Length, 6-8 mm.

MALE.—The under surface is similar in color to the upper with the exception that the last two abdominal segments are slightly darker. These two segments (Fig. 2) are emarginate, the emargination on the penultimate is ovate in form; the last segment is opened at the base but closed at the apex. (If these segments were brought together, it would possibly appear as a single opening.) The sides of the last abdominal segment are impressed basally.

FEMALE.—The two apical segments of the abdomen are black and finely punctured; the seventh segment is short, rounded at the sides and with a circular emargination at the apex; the dorsal part is also emarginate and the next to last dorsal segment is impressed at the middle, raised at the sides and with two small hairy protuberances at the apical angles.

Length, 6-8 mm.

Holotype male and allotype female in the collection of the Museum of Comparative Zoölogy. These were collected by Dr. P. J. Darlington at Soledad (Cienfuegos), Cuba.

This species although similar to *rubidus* is paler red in color. The elytra are less broadly rounded at the apex, and the emargination of the apical abdominal segments are totally different.

Tytthonyx darlingtoni, new species

Figures 4 and 5

MALE.—Elongate, clothed with fine sparse pubescence. Head red, microscopically reticulate punctulate, sparsely covered with very short pale pubescence; antennae excepting apical joint black, strongly serrate from third to tenth joint, basal joint slightly club-shaped, nearly twice as long as the second, eleventh joint

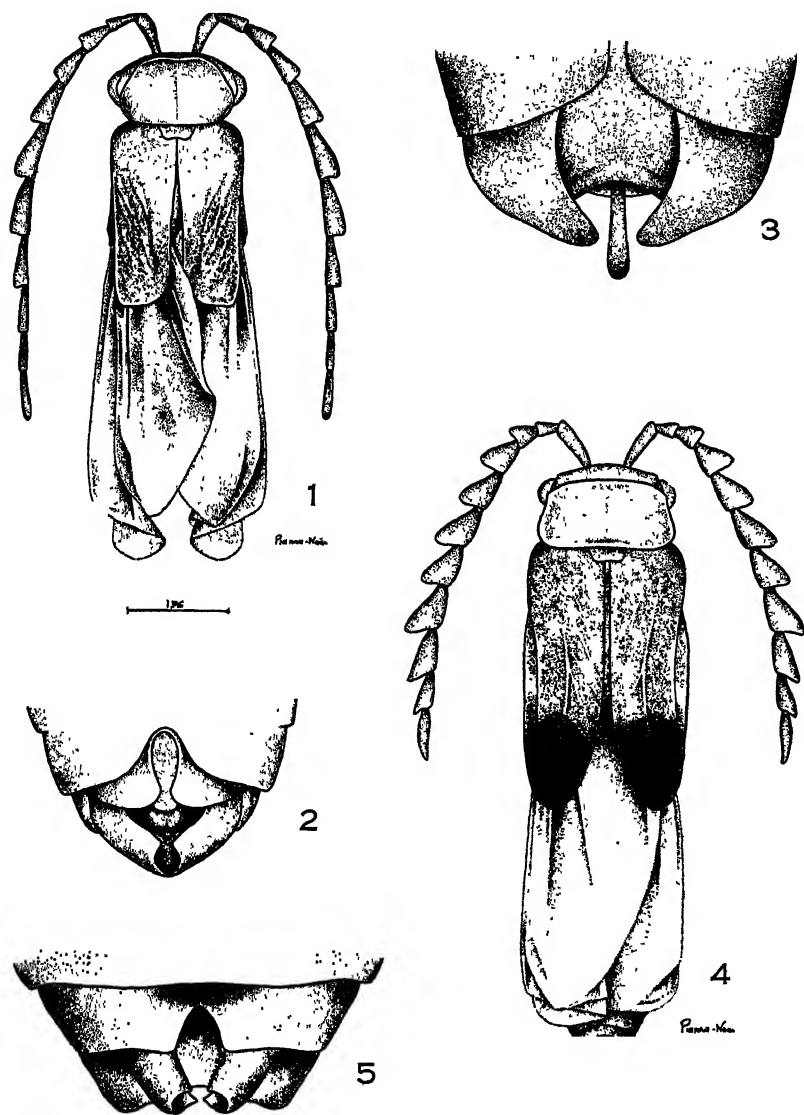


Fig. 1. *Tytthonyx rutilis*, new species.

Fig. 2. *Tytthonyx rutilis*, apical ventral segments of male.

Fig. 3. *Tytthonyx rubidus*, new species, apical ventral segments of male.

Fig. 4. *Tytthonyx darlingtoni*, new species.

Fig. 5. *Tytthonyx darlingtoni*, apical ventral segments of male.

elongate ovate, pale yellowish brown in color; palpi black. Pronotum red, about two-fifths wider than long, surface smooth, pubescence pale, very short and sparse, margins somewhat raised; disk with a median longitudinal impression and with a somewhat shallow broader impression on each side, front and hind angles rounded. Elytra slightly more than half the length of the body, parallel to about the apical third, then gradually narrowing to apex, sutural and lateral angles broadly rounded; red at base, apex black, covered with short, sparse, red pubescence, surface confusedly punctate giving it a roughened appearance, each with a more or less distinct oblique costa reaching from near the humerus to within a short distance from the apex. Underwings black. Body beneath red with middle of penultimate and last segment black; sixth segment emarginate at apex; seventh segment with an emargination on both ventral and dorsal parts which makes this segment appear divided (Fig. 5); margins of apex and those of emargination with bristle-like black hairs. Femora, tibiae and tarsi black. Length, 5.5-7 mm.

Type and two paratypes collected by Dr. P. J. Darlington at Buenos Aires, Trinidad Mts., Cuba, May 8-14, 1936, at an elevation of 2500 to 3500 feet.

Type and one paratype in collection of the Museum of Comparative Zoology. One paratype in the collection of The American Museum of Natural History.

The antennae of this species are more strongly serrate and the emargination of the apical ventral segments differs from the other two species herein described. The elytra are similar in shape to the next *rutilis* but only about two-thirds of the elytra are red, the apex being black.

Tytthonyx rubidus, new species

Figure 3

Elongate. Head, thorax, elytra and basal abdominal segments red; palpi, antennae, underwings, legs and two apical segments of abdomen, black. Head longer than wide, very finely (not closely) punctate, and with very short pale pubescence. Pronotum about one-third wider than long, margins raised; disk very slightly convex, with an indication of a longitudinal median impression basally and apically; at basal half of the disk there is a vague impression, the base of which is narrow but expands toward the apex; the disk is extremely finely punctate and sparsely covered with very short, fine pubescence; front somewhat narrowly rounded; hind angles obtuse. Scutellum of the same color as the pronotum. Elytra about two-thirds longer than the thorax, darker red in color than head and thorax; pubescence pale, short and more or less sparse; punctures coarse and irregular, quite sparse at base but becoming more closely placed and more irregular apically; viewed from the side there are on each elytron four apparent costae which extend neither to the base nor apex, the outward costa appearing the most prominent; from the humerus is a more or less wavy costa-like ridge which beyond the apical half is coarsely punctured and separated so as to form a shorter costa. Body beneath excepting sides and apex of abdominal segments with short, sparse pubescence; these latter have longer and coarser hairs. Length, 5-5.5 mm.

MALE.—Last ventral segment (Fig. 3) with a broad arcuate emargination. The sides and apex of the segment are strongly punctate with stiff hairs arising from the punctures. Part of the oedagus protrudes through the middle of the emargination.

It is nearly parallel-sided but broadens slightly apically and the lower surface is sparsely punctured apically, with stiff hairs arising from the punctures.

FEMALE.—Sixth abdominal segment broad at base, apex broadly but very slightly emarginate; at the sides and apex there are a few short somewhat coarse hairs; slightly protuding beyond this segment is a narrower segment which in our specimens is apparently widely open at the apex. It is margined with stiff dark hairs and the opening is lined with paler hairs.

Holotype male, allotype female, and three male and one female paratypes in collection of the Museum of Comparative Zoölogy. One male and one female paratype in collection of The American Museum of Natural History. All of the above were collected by Dr. P. J. Darlington, at Buenos Aires, Trinidad Mts., Cuba, May 8-14, 1936. Altitude 2500 to 3500 feet.

The elytra of this species are similar to *darlingtoni* in form but they are not black at the apex; the surface sculpture also differs. The emargination of the apical ventral segments differs from both of the preceding species.

AMERICAN MUSEUM NOVITATES

Number 925

Published by
THE AMERICAN MUSEUM OF NATURAL HISTORY
New York City

May 7, 1937

TWO REVERSED PARTIALLY AMBICOLORATE HALIBUTS: *HIPPOGLOSSUS HIPPOGLOSSUS*

By E. W. GUDGER AND FRANK E. FIRTH

INTRODUCTION

In 1935, we published an article on an almost totally ambicolorate halibut with a partially rotated eye and a hooked dorsal fin. This fish (the most abnormal halibut ever described up to that time) was normal in only one thing—it was right-handed or right-pointing or dextral. The two halibuts now under consideration show much less coloration on the under side than does the 1935 specimen, and have no head anomalies. However, they are not merely partially ambicolorate but have the added anomaly of being reversed or left-handed. Firth obtained these from fishing vessels discharging at the Boston Fish Pier. The history of each will be given later.

THE NORMAL FISH

In order that the marked abnormalities of our fish may be more readily perceived and understood, we insert here a figure showing the right or upper side of a normal halibut. In this figure, attention is called to three particular structures in the make-up of this, the largest member of the flatfish group: (1) Along the dorsal and ventral edges of the dextral or upper side are certain small whitish blotches. Whatever the cause, these are not abnormalities, since they are generally present and are more readily seen on the larger halibuts. (2) Note the large jaws filled with large strong recurved teeth. These indicate that our fish is an active predator. (3) Particular attention is called to the very high position of the upper, the rotated or left eye. While clear of the dorsal crest, it is very close to this. Furthermore, the anterior termination of the dorsal fin reaches to and often beyond the middle point of this migrated eye. See Fig. 1. The whole lower surface of this normal fish is of course dead white in color.

It should be stated here that at Boston and Gloucester two grades of halibut are distinguished: First, those fish having pure white under sides,

which bring the highest price; and second, those having the under side of a more or less uniform grayish cast. These bring a lower price. These are called "gray halibut" and are generally the larger fishes. However, the grays are halibut and are recognized by the fishermen as different from the others only in this matter of the faint lower-side coloration. This grayish color, has, moreover, nothing to do with ambicoloration.

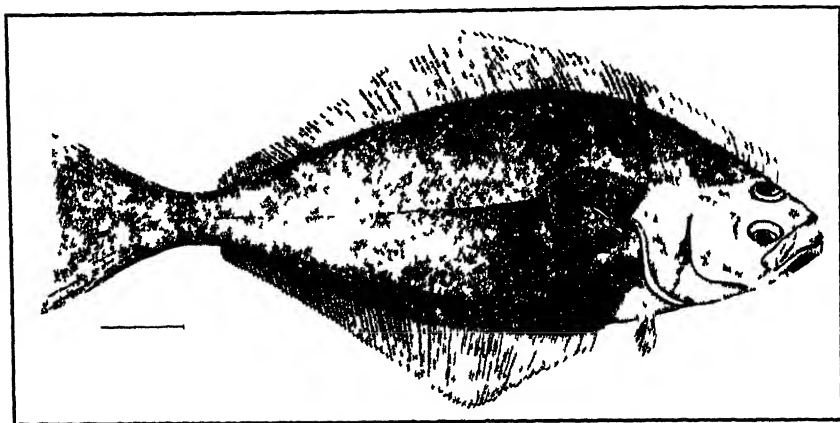


Fig. 1. Upper surface of a normal halibut, *Hippoglossus hippoglossus*. Note that the rotated eye is placed high on the side of the head, near the dorsal crest but free of it, and that the dorsal fin ends in line with the middle of the rotated eye.

The spots on the dorsal and ventral edges of the body are not abnormalities, as the text explains.

After G. Browne Goode, 1884.

THE ABNORMAL FISH

Each of our specimens presents a double anomaly—each is reversed, i.e. is sinistral or left-pointing; and at the same time is partially ambicolorate, i.e. has the normally-white lower side more or less colored.

THE REVERSED HALIBUTS

A halibut is an abnormal fish in that, instead of swimming with its dorso-ventral axis standing vertically, it lies and swims on one side with this axis in a horizontal plane. Moreover each genus of flatfishes has a definite side on which normally to lie. Thus the halibut lies on its left side, which is blind and white, while its right or upper side is colored and eyed (Fig. 1). It is then dextral or right-pointing.

To become reversed, it must be turned from right to left on its tail as an axis so that the left side is now above, eyed and colored, while the former eyed and colored right side now becomes the lower, blind or white side. This is what has happened to both our fish. Both have become sinistral, left-pointing.

Since no reversed halibut has ever been figured and described, we call attention in Fig. 2 to the smaller of our left-handed fish. It is uniformly dark-colored throughout save for certain white areas in the tail-fin and certain white irregular-shaped blotches just under the bases



Fig. 2. A reversed halibut (*Hippoglossus hippoglossus*), the first ever figured. This fish is normally right-pointing. At bases of dorsal and anal fins are white blotches which have come over with the color. Compare this fish with the normal one in Fig. 1.

Photograph by A. M. N. H.

of dorsal and anal fins. These latter correspond to what are shown in Fig. 1 and described in the section on the normal fish. They are normal features which have come over on the left side in the reversal of surfaces. On the tail are white areas, which (as will be seen later) correspond to what are found on the under side.

Reversed specimens of *Hippoglossus* are exceedingly rare. In a prolonged search of the literature, Gudger (1935, p. 14) could find but 3 brief records—not descriptions. Storer (1839, p. 146) remarks that reversed specimens of the great halibut are occasionally met with and that in 1838 he had seen in the Boston market, such a fish weighing 103 lbs., “with the left side colored, [and] bearing the eyes.” In the section on the halibut in his book, Goode (1884, p. 197) states that left-handed specimens are sometimes taken—“about one in five thousand...

having the eyes on the left rather than upon the right side of the head." And Parker (1903, p. 232) found but one sinistral individual among all the halibuts handled in Boston in the winter of 1900-1901 by the largest halibut establishment there. "It was certainly a single individual in many thousands."

Of the closely related form, *Reinhardtius hippoglossoides*, Norman in his great book on the "Flatfishes" (1934, p. 290) records that he saw a reversed specimen in the "Dana" collection from off northern Iceland. Lastly, Jordan and Evermann say that in *Hippoglossoides classodon* occasional sinistral specimens are found; but Norman found none in the U. S. National Museum material examined by him.

All this is to say that reversal in halibuts is an almost unknown phenomenon. Hence our specimens from this point of view only are exceedingly interesting. Since no figure of a reversed halibut has ever been published, we reproduce here from a photograph the upper surface of our smaller fish as Fig. 2. But the anomalies of our specimens do not stop with simple reversal—as we shall now show.

AMBICOLORATE REVERSED HALIBUTS

In ordinary reversed flatfishes, the reversed sides have reversed colors—the normally blind and colorless lower side, becomes the upper, colored, and eyed side; and the normally eyed, colored, upper side, becomes the lower white blind side. Our specimens are blind below but are partially ambicolorate, i.e., partially colored like the upper side. This we will now show for each fish separately.

The Smaller Fish.—This interesting specimen was taken on June 24, 1935, by the boat "Gertrude De Costa," Capt. Albert Hines master, fishing in 75 fathoms in one locality from 5 to 15 mi. N. W. of Brown's Bank, which is about 50 miles S. S. W. of Cape Sable, Nova Scotia. It was taken in a line-trawl catch of about 5000 lbs. of halibut of similar size, and so far as Firth could learn was the only fish of the kind in the lot. When received by Firth at the Boston Fish Pier on June 27, it measured over all 17.9 in., was 6 in. wide (body only) and weighed 27 oz. The great halibut (*Hippoglossus hippoglossus*) grows literally to a great size. Goode (1884, pp. 193-194) quotes Captain Atwood (everywhere in his day accredited as an exceedingly accurate observer) that in 1879 he saw specimens which weighed 359 lbs. (302 dressed) and 401 (322 lbs. dressed). Goode says such fish would have measured between 7 and 8 ft. long and 4 ft. wide. Hence it is seen that our fish is a mere baby, but a most interesting specimen nevertheless.

Our fish is reversed, and as such it has been described. Hence nothing more need be said save to note the inequality in size of the pectoral fins. The fin on the blind side (under—right) measures 43 mm. while the one on the eyed (upper—left) side is 60 mm. long, or nearly 40% longer. This inequality has been noted in the pectorals of other flatfishes. The flatfishes are bottom dwellers and (mostly) bottom swimmers. As such, it is pretty clear that in our fish the left pectoral would be more used than the right, and hence would be better developed. This inequality in size of the pectorals may be demonstrated



Fig. 3. Lower (right) side of halibut, *Hippoglossus hippoglossus*, seen in Fig. 2. This reversed side should be white but is partially ambicolorate.

Photograph by A. M. N. H.

by measuring the left pectoral in Fig. 2 and the right one in Fig. 3 (made on the same scale). The lower side of this specimen is ambicolorate as Fig. 3 shows. Almost the hinder half of the tail-fin is white, but all told approximately one-third of the under area is colored almost exactly as is the upper side. As Fig. 3 shows, the line separating the light and dark areas is a very irregular one. Along the lateral line the color extends forward in a peninsula bounded above and below by white bays. On either side of these but especially on the ventral edge, the dark areas extend forward on body and on the unpaired fins. The anal fin shows more dark, and this color extends forward to the anal region and connects up with a dark area coming over from above and covering the lower forward fourth of the visceral region. Noticeable are the dark islands scattered (four above and one below the lateral line) about in the white area. Since there are no spots on the upper surface, there is

no correlation here as in the case of the four-spotted flounders (*Paralichthys oblongus*) described by Gudger and Firth in 1936. The front base and nearly the forward half of the pectoral are dark. It is interesting to note the white color of the spread out fin-rays of the caudal. This was observed by Firth on the fresh fish and we judge it to be the original white color of the under side and not an artifact due to scraping off of the epidermis.

Specimen No. II.—Our larger fish was taken on May 20, 1935, by the schooner "Adventure," Captain Leo Hines master, while fishing for cod and haddock about 60 mi. E. by S. of Sable Island in 75 to 80

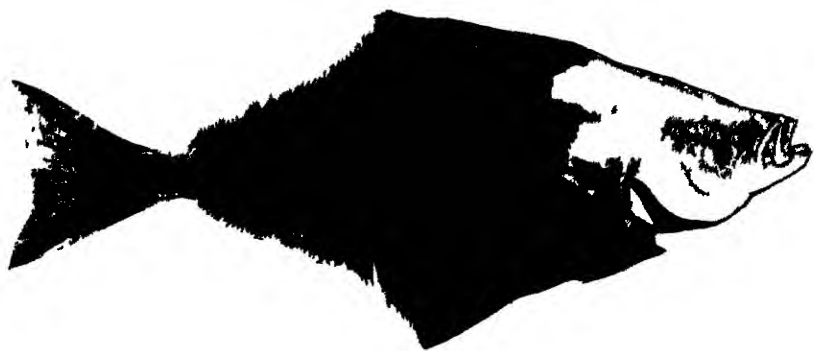


Fig. 4. The ambicolorate lower side of our larger (30-inch) reversed halibut (*Hippoglossus hippoglossus*). This fish and that shown in Fig. 3 are the only ones of their kind ever figured.

Photograph by A. M. N. H.

fathoms. Our fish was actually caught by Larry Nolan and Lawrence Goodwin, dorymates, who found it on one of their trawl hooks. Not being interested in "chicken halibut" (the name given these small fish by the trade) they were of half a mind to throw it back, but noticing that it was a freak fish they fortunately kept it. When Firth saw it at the Boston Fish Pier, he at once seized it in the interest of science.

When the fish came off the boat, Firth took its measurements as follows: length, 30 in.; width (body only), 9 in.; weight, 9.5 lbs. He was greatly pressed with other work, so he had the fish put in the freezer and later sent it frozen to New York by express. Gudger (also crowded with work) did not properly defrost the specimen and because of its large size put it in a tank of strong salt solution instead of alcohol. As a result of these two errors, the epidermis began to slip and the fish

showed signs of breaking up. It was at once put in alcohol, and as soon as it had hardened somewhat it was photographed.

The upper side has been badly mauled, but is dark throughout like the upper side of a normal fish save that the hinder part of the tail-fin is light—very like what is seen in the upper side tail of our smaller specimen (Fig. 3). Such is Firth's description of the fresh fish. There are no eye nor dorsal fin anomalies. The upper side of our smaller fish being entirely normal (Fig. 3), there is no need to figure the mauled and defective upper side of the larger specimen.

Our interest centers in the under side—excellently shown in Fig. 4. Here the slipped epidermis (very slight in amount compared with that on the upper surface) has been restored in accordance with Firth's description of the fish when fresh and with what Gudger found when he unpacked the fish. The retouching was done under Gudger's eye by a skilled artist, accustomed to work on fishes. Fig. 4 shows the fish as it was when it came off the boat. The three dark areas on the front head region are abrasions in the white skin made in handling the fish on the boat.

The anal fin is dark throughout, the hinder half of the caudal and the pectoral fin each is white, that of the pectoral a dead white like the region above the shoulder and over the head. The throat region and the under and hinder parts of the branchiostegal region are dark. It should be noted that the under side of the dorsal fin is dark up to the beginning of the white shoulder region and that adjacent to the white shoulder and head region it is intermediate in hue between the dark of the body generally and the light of the anterior white parts. Since the dark area does not encroach on the head region, there are no eye nor dorsal fin anomalies. This is in conformity with the general rule, to which thus far but two or three exceptions have been found.

These are the only reversed ambicolorate halibuts on record, hence they are unique—there are no others known. However, there are on record two other reversed ambicolorate flatfishes. Gudger has recently described (1936) a reversed almost wholly ambicolorate summer flounder *Paralichthys dentatus*. This fish (15 inches long) had the whole lower body and about half the head as dark as the upper side. Hence, in accord with the general rule it had an almost cyclopean eye and a hooked dorsal fin. Furthermore, Cunningham (1907) has figured and described a reversed small turbot (44 mm., 1.7 in. long) partly ambicolorate on the blind side and white on the eyed side. It, however, was hardly more than a post-larval young.



Fig. 5. Ventral surfaces of two halibuts (*Hippoglossus hippoglossus*). The smaller fish has the normal white under surface. The larger or abnormal fish is nearly completely dark below, has an incompletely rotated eye and a hooked dorsal fin—both of which are absent in the normal fish.

From a photograph in A. M. N. H.

Statement has been made of the fact that in cases of extreme ambicoloration—when as much as one third of the head and cheek region is colored, then one may expect to find an incompletely rotated eye and a hooked dorsal fin. Since we have figured such an anomaly in a large dextral *H. hippoglossus* secured by Firth in Boston early in 1935, and since the cut is at hand for giving an illustration, we reproduce this fish as Fig. 5. This shows the three common anomalies well and calls for but one other remark. It should be noted that the large ambicolorate fish of Fig. 5 like our two specimens shown in Figs. 3 and 4 has not only a partially white head, but also has the hinder halves of both pectoral and caudal uncolored.

No explanation is at hand for any or all of these anomalies. This must be found in genetics, a subject in which neither of us is versed enough to warrant an excursion. Later, the senior author plans to bring together in general articles all the records of ambicoloration wherever published in the hope that therein some understanding may be found of this and the accompanying anomalies.

BIBLIOGRAPHY

CUNNINGHAM, J. T.

1907. 'A Peculiarly Abnormal Specimen of the Turbot.' Journ. Mar. Biol. Assoc., (N. S.) VIII, pp. 44-46, Pl.—Proc. Zool. Soc. London, pp. 174-181, Pl.

GOODE, G. B.

1884. 'The Flat Fishes and Flounders.' (In his 'The Fisheries and Fishery Industries of the United States.' Section I, Text. The Halibut, pp. 189-197.)

GUDGER, E. W.

1935. 'Abnormalities in Flatfishes (Heterosomata). I. Reversal of Sides: a Comparative Study of the Known Data.' Journ. Morphol., LVIII (halibuts, p. 14).
1936. 'A Reversed almost Wholly Ambicolorate Summer Flounder, *Paralichthys dentatus*.' Amer. Mus. Novitates, No. 896, 5 pp., 3 Figs.

GUDGER, E. W., AND FIRTH, FRANK E.

1935. 'An Almost Totally Ambicolorate Halibut, *Hippoglossus hippoglossus* with Partially Rotated Eye and Hooked Dorsal Fin—the only Recorded Specimen.' Amer. Mus. Novitates, No. 811, 7 pp., 2 Figs.
1936. 'Three Partially Ambicolorate Four-spotted Flounders, *Paralichthys oblongus*.' Amer. Mus. Novitates, No. 885, 9 pp., 6 Text-figs.

NORMAN, J. R.

1934. 'A Systematic Monograph of the Flatfishes (Heterosomata).' Vol. I. (Halibuts, pp. 287-302, 10 Figs.)

PARKER, G. H.

1903. 'The Optic Chiasma in Teleosts and its Bearing on the Asymmetry of the Heterosomata (Flatfishes).' Bull. Mus. Comp. Zool., XL.
(Reversed halibut, p. 232.)

STOREY, D. H.

1839. 'Reports on the Fishes, Reptiles and Birds of Massachusetts.'
Boston. (Reversed halibuts, p. 146.)

AMERICAN MUSEUM NOVITATES

Number 926

Published by
THE AMERICAN MUSEUM OF NATURAL HISTORY
New York City

May 12, 1937

THE NEOTROPICAL SPECIES OF *MELANOSTOMA* AND ALLIES (SYRPHIDAE: DIPTERA)

By C. H. CURRAN

A study of the Neotropical material belonging to *Melanostoma* Schiner and allied genera necessitates a realignment of the species formerly placed in this genus. Most of the forms belong in the genus *Rhysops* Williston, only four belonging, with certainty, to *Melanostoma*. As a key to the species of *Xanthandrus* Verrall will be published elsewhere by Dr. C. L. Fluke, I do not include one in this contribution.

TABLE OF GENERA

- 1.—Antennae elongate, the second segment longer than wide, the first and third also elongate. *Rhysops* Williston.
Antennae shorter, the second segment short and wider than long. 2.
- 2.—Face rather narrow and narrowed below; abdomen broad and flattened.
Xanthandrus Verrall.
Face at most with parallel sides or widened below, abdomen narrower.
Melanostoma Schiner.

RHYSOPS WILLISTON

WILLISTON, 1907, Journal N. Y. Ent. Soc., XV, p. 2.

Braziliana CURRAN, 1925, Ann. Mag. Nat. Hist., XVI, p. 252.

Rhysops was established by Williston for three species he had previously placed in *Melanostoma* Schiner, characterized by their elongate antennae and the presence of transverse grooves across the middle of the face. In 1910 Coquillett selected *rugosus* Williston as the genotype. *Braziliana* was proposed in 1925 for *Melanostoma longicornis* Williston, a species having elongate antennae but lacking the transverse facial grooves.

A study of the material now before me shows that the differences between these two groups are not of generic value and it becomes necessary to revise my earlier view. I do not doubt that *Rhysops* can be maintained as distinct from *Melanostoma* Schiner although the dividing line is not as well marked as one would like to have it. However, I have found no specimens of *Melanostoma* in which the second antennal segment is longer than wide and there seems to be no intergradation in this respect.

TABLE OF SPECIES

- 1.—First antennal segment as long as the second and third segments combined. . . 6.
Third segment about as long as the first or as the first two combined. 2.
- 2.—First and third antennal segments of equal length, the face without transverse ridges. *catabomba* Williston.
Third segment as long as the basal two combined. 3.
- 3.—Wings with two short, transverse spots in front on the median half.
scitula Williston.
Wings without such markings. 4.
- 4.—At least the middle tarsi wholly brownish yellow or reddish. 5.
Tarsi black with the basal segments reddish yellow (Costa Rica).
melanocera Williston.
- 5.—Face with five transverse grooves across the middle (Mexico).
rugonassus Williston.
Face without distinct transverse grooves (Brazil). *lanei* Fluke.
- 6.—Face with three or four transverse grooves across the middle above the tubercle;
wings with two short, narrow transverse brown bands near the middle on the
anterior half (Mexico). *crenulata* Williston.
Face with at most one groove above the tubercle, wings without transverse
bands but with weak apical cloud in front. 7.
- 7.—Anterior legs wholly yellowish (Peru). *peruviana* Shannon.
Anterior femora black on basal third or more (Brazil, Colombia).
longicornis Williston.

MELANOSTOMA SCHINER

- 1.—Pollen of the face with numerous small shining black spots (Chile, Argentina,
Southern Brazil). *punctulatum* Wulp.
Pollen without such spots. 2.
- 2.—Anterior four femora wholly reddish (Brazil). *tropicum*, new species.
Anterior four femora broadly black basally or almost all black. 3.
- 3.—Face perpendicular (Brazil). *neotropicum*, new species.
Face produced forward below (Chile). *fenestratum* Macquart.

The species *annuliferum* Bigot and *bellum* Giglio-Tos are unknown to me and I am unable to place them. *M. anthracoides* Bigot, from Panama, belongs to the genus *Baccha*. *M. euceratium* Bigot, from Mexico, belongs to *Xanthandrus*.

Melanostoma punctulatum Wulp

WULP, 1888, Tijds. v. Ent., XXXI, p. 375.

This species has been placed as a synonym of *stegnum* Say. It is a very different insect. The wide geographical separation of the two species will serve for ready identification.

Two specimens from Chile and four from São Paulo, Brazil (J. Lane).

***Melanostoma fenestratum* Macquart**

Syrphus fenestratus MACQUART, 1842, 'Dipt. Exot.', II, pt. 2, p. 103 (f.).

There seems to be no excuse for the placing of this species as a synonym of *stegnum* Say. The facial pollen is not at all punctate and the profile is quite different. The species appears to be common in Chile and is well represented in our collection.

***Melanostoma tropicum*, new species**

Black; abdomen with three pairs of reddish spots; legs reddish, the hind pair mostly brown. Length 10 mm.

MALE.—Face almost perpendicular, the tubercle low but distinct, narrowly separated from the anterior oral margin; sides of the face thickly cinereous yellow pollinose, the median fifth shining black and not at all ridged or grooved; pile pale yellowish. Frontal triangle brownish yellow pollinose with a shining, roughened area above the antennae; pile black. Vertical triangle thinly brownish pollinose and blackish pilose. Occiput and cheeks cinereous pollinose, the pile whitish, the upper occipital cilia fine and black. Antennae reddish, the third segment brown above and apically; arista brown; third antennal segment one-half longer than wide as long as the basal two segments combined; antennae reaching to a little below the middle of the face.

Thorax shining aeneous; mesonotum with a pair of very broad, narrowly separated pale pollinose vittae in the middle on the anterior half and in some lights with thin brownish pollen; pleura mostly thinly grayish brown pollinose. Pile tawny, paler on the pleura.

Legs reddish, the coxae mostly black; posterior legs brown, their femora reddish on almost the basal half; pile reddish, black on the brown portions and on the apical segments of the tarsi.

Wings cinereous hyaline with luteous tinge; stigma luteous. Squamae with brown border and fringe. Halteres orange.

Abdomen black with three pairs of reddish spots. First segment shining with the sides and anterior border obscurely reddish, second segment opaque black with the lateral sixth reddish, the apical seventh less clearly so. Third segment opaque black with the pale spots extending from the base to the apical fourth, gently tapering posteriorly and broadly separated from the lateral margins by a sub-shining stripe; the reddish spots on the fourth segment extend to the apical third and the posterior margin is broadly sub-shining; fifth segment very short and wholly shining. Pile short and black, long and yellowish on the sides of the first two and basal half of the third segment. Venter metallic brownish red with mostly black pile. Genitalia mostly brownish red and with thin yellowish brown pollen. The abdomen is long and slightly spatulate, being narrowest at the end of the second segment and widest at the end of the third.

Types.—Holotype, male, and paratype, male, C. do Jardim, São Paulo, Brazil, January 23, 1936 (F. Lane).

Melanostoma neotropicum, new species

Somewhat similar to *tropicum* Curran but the abdomen has parallel sides and the legs are mostly black. Length, 9.5 mm.

MALE.—Head black, cinereous pollinose, a wide facial vitta, an arched spot above the antennae and the vertical triangle bare; frontal pollen yellowish brown except along the orbits; pile white, black on the front, vertical triangle and along the middle of the upper half of the sides of the face. Face almost perpendicular in profile, the tubercle very low and narrowly separated from the oral margin; above the tubercle with three broad, low, transverse ridges. Antennae short, brown, second segment very broadly reddish below, the third broadly reddish below on the basal half or more; arista brown.

Thorax shining greenish black; mesonotum in front with a pair of narrowly separated grayish vittae extending to the middle; pleura thinly cinereous pollinose. Pile pale tawny, moderately short, paler on the pleura, and longer on the scutellum.

Legs black, the narrow apices of the femora and broad bases of the tibiae reddish, the posterior tibiae more brownish red basally. Pile mostly short and black.

Wings cinereous hyaline, with luteous tinge; stigma luteous; anterior cross-vein weakly clouded with brown. Squamae with brown border and fringe. Halteres reddish yellow.

Abdomen opaque black with three pairs of yellow spots, the first segment and sides of the abdomen shining. The yellow spots on the second segment are long and narrow, beginning at the basal fifth of the segment and extending to the apical fourth, broadly separated from the lateral margins. The spots on the third segment are broader, about twice as long as wide, broadly separated from each other and from the lateral margins, with almost parallel sides, obtusely rounded posteriorly and extending from the base to the apical third of the segment. The spots on the fourth segment are of the same width as those on the third but are less distinct and do not reach the middle of the segment. Pile short and black, longer and yellow on the sides of the first two segments and on the yellow spots, pale on the sides of the basal half of the third segment; fourth segment sub-opaque, the fifth very short and shining. Venter black with the third sternite yellow on more than the basal half. Genitalia black.

HOLOTYPE.—Male, São Paulo, Brazil, 1935 (A. A. Barbiellini).

AMERICAN MUSEUM NOVITATES

Number 927

Published by
THE AMERICAN MUSEUM OF NATURAL HISTORY
New York City

May 12, 1937

NEW REPTILES FROM THE EOCENE OF SOUTH AMERICA

BY GEORGE GAYLORD SIMPSON¹

Among the specimens collected by the Scarritt Patagonian Expeditions of The American Museum of Natural History there are representatives of two new reptiles so remarkable that it is desirable to give preliminary notice of their existence. Detailed monographs on each are being prepared but cannot be completed for some time.

The first of these reptiles may be known as *Sebecus icaeorhinus*, new genus and species, type Amer. Mus. No. 3160, most of the skull and jaws, largely disarticulated but splendidly preserved. *Sebecus* is a thecodont archacosaur and is remotely crocodile-like, but instead of the depressed or quadrate snout of all known crocodiles it has the whole facial region high and strongly compressed laterally, the general habitus like some of the phytosaurs except that the external nares are terminal. The lower jaw also is deep and narrow relative to the crocodiles. The symphysis is moderately long and involves the splenial. Articulation of jaw and skull is double, with a well-developed and separate surangular-quadratejugal articulation in addition to the usual articular-quadrate connection. The teeth, except those in the premaxilla, are strongly compressed laterally and have sharp, serrated edges, the larger teeth being almost exactly like those of some carnivorous dinosaurs but with crocodile-like roots.

A secondary palate is present, but it differs from those of any known crocodiles, including the Mesosuchia. The pterygoids are not involved and the remarkably wide internal nares, at the posterior edge of the short palatines, extend as far forward as the suborbital vacuities. The palatine tube, so typical of even the primitive crocodiles, is thus practically absent.

This animal is so decidedly distinct that detailed comparison with other forms is hardly possible, but it is probably more nearly related to the Crocodilia than to other previously known reptiles. Even this relationship must be remote and any common ancestry could hardly be later than the Triassic and would be doubtfully crocodilian. At the least, *Sebecus* must represent a new suborder of Crocodilia, differing

¹ Publications of the Scarritt Expeditions, No. 28.

more from the other suborders than they do among themselves, and it may be necessary to place it in a new order of Archaeosauria. For this new group, whatever rank may ultimately be given it, I propose the name *Sebecosuchia*. Its only known family is at present the *Sebecidae*, new. These groups are sufficiently characterized in a tentative way by the high, narrow face, primitive type of secondary palate, and double jaw articulation. There are numerous other fundamental differences from any other archaosaurs.

The Ameghino Collection includes at least one tooth of *Sebecus*, identified by both Ameghino and von Huene as a dinosaur but not named. This was the best single item of Ameghino's evidence for dinosaurs in the Casamayor Formation. Von Huene questioned its derivation from that horizon, which is now confirmed as accurate, like almost all Carlos Ameghino's field data, but the identification as a dinosaur, although inevitable on that evidence, was incorrect.

Mingled with the type specimen of *Sebecus* were disarticulated fragments of a turtle skull which prove to represent most of the cranial roof, the posterior frill, quadrate, ear region, and most of the braincase. These reveal a horned turtle evidently allied to the Australian post-Pliocene *Meiolania* and to the South American Cretaceous or Eocene *Niolamia* but quite distinct from either. The large horn cores, on the squamosals, are less prominent than in either of those genera and the frill less expanded, with smaller cores formed in part by the squamosals and in part by the supraoccipital, which is widely exposed dorsally and meets the squamosals. A fenestra is left open on each side between the parietal, which does not reach the posterior edge of the skull, the supraoccipital and the squamosal. The horns and frill are thus less complete or advanced than in *Meiolania* or *Niolamia* although the boss-like dorsal scale areas in general are well differentiated and sharply separated by grooves. The disarticulated and uncrushed nature of the specimen, like that of *Sebecus*, reveals many important anatomical features to be described and illustrated in detail in a later paper. This turtle is evidently a new member of the family *Meiolaniidae* and for it I propose the name *Crossochelys corniger*, new genus and species, type Amer. Mus. No. 3161.

The presence of a supratemporal opening, clearly shown in this specimen, is unique among chelonians. It is, however, almost certain that this is not the temporal opening seen in the synapsids or the upper opening of the diapsids. It is taken to be a secondary structure arising from an emarginate chelonian skull by the posterior junction of ex-

panded squamosals and supraoccipital. Their farther expansion would obliterate the openings and produce a secondarily entire temporal covering, as had probably occurred in *Niolamia*.

The only previously known South American meiolaniid is *Niolamia argentina*. This resembles the Australian genus *Meiolania*, to which it is often referred, more closely than *Crossochelys* resembles either *Meiolania* or *Niolamia*. The age of *Niolamia* is not surely known and it may be contemporaneous with *Crossochelys* or may be older.

The specimen of *Crossochelys*, while less complete than the best known skulls of *Meiolania* and *Niolamia*, is more revealing as to many important details of the cranial structure and will have an important bearing on the affinities of the Meiolaniidae. These are usually referred to the Pleurodira, but Anderson has adduced evidence from *Meiolania* for placing them in the Amphichelydia. Preliminary study of *Crossochelys* tends to confirm this view and to oppose any close connection with the pleurodires.

The types of *Sebecus icaeorhinus* and *Crossochelys corniger* were found in a greenish stratum of bentonite in Cañadón Hondo, southern Chubut, Argentina. At the same horizon and locality were found many excellent specimens of birds, evidently new, rare mammals, and new lower vertebrates, all yet to be studied. The stratum represents a peculiar facies, not observed at any other locality, within the Casamayor Formation, or *Notostylops* Beds of Ameghino, of Eocene age. A second, much less perfect specimen of *Sebecus* was found at Cañadón Vaca, not far from Cañadón Hondo, associated with a large and characteristic Casamayor mammalian fauna. *Crossochelys* is now surely known only by a single specimen. It is, however, possible that some of the fragments hitherto referred to *Niolamia* (or to *Meiolania argentina*) really belong to *Crossochelys*, since the existence of this distinctive second genus in South America was not suspected and any material representing a horned turtle was referred without question to the known form.

AMERICAN MUSEUM NOVITATES

Number 928

Published by
THE AMERICAN MUSEUM OF NATURAL HISTORY
New York City

8-2-37
June 2, 1937

SOUTH AMERICAN BEES

By T. D. A. COCKERELL

The holotypes of the new forms will be found in The American Museum of Natural History.

Centris (Hemisia) nitens callospila, new variety

MALE.—Length about 13 mm., anterior wing about 10 mm.; pubescence entirely pale, on head and thorax white, with a faint creamy tint on vertex and dorsum of thorax; eyes very large, light yellowish brown; face narrow; clypeus (except a broad black band on each side of upper part), a triangular supraclypeal mark (the lateral extensions almost linear), lateral marks filling space between clypeus and eye, mandibles (except the apical part, which is strongly bidentate), labrum entirely, and scape in front, all bright lemon yellow; flagellum obscurely reddish beneath, with no distinct red spot on third joint; scutellum red, but the rest of thorax black; tegulae testaceous; wings brownish hyaline, not dark, stained along the veins; legs very dark reddish basally, but tibiae and tarsi, and apical half of femora, clear red; a small yellow spot on each knee; no stripe on front tibia; spurs red; abdomen smooth and shining, bluish green shading to brassy green, the margins of the tergites broadly pallid, not covered by hair, except that the apical segments have much white hair; five tergites are green; what can be seen of the sixth, and the apex, are light red; sides of tergites 2 to 5 with large lemon-yellow spots; venter light red, with a blackish stain in middle.

British Guiana: Waranama, Nov. 14, 1936 (J. Ogilvie). Closely resembles *C. bakeri* Cockerell, from Brazil, but differs by the pale dorsal pubescence, lack of fuscous hair on vertex, paler wings, more red on legs, no yellow stripe on front tibiae, no black hair on hind tibiae, fifth tergite green, four yellow spots on each side of abdomen. It is very like the male *C. nitens* Lepeletier, as I have recognized it from Waranama (whence come females of *C. nitens* also), but that has red hair on head and thorax above, dilute fuliginous wings, a conspicuous red spot at end of third antennal joint, and abundant long fulvescent hair on hind margins of posterior tibiae and tarsi. Yet the resemblance is so close that I provisionally regard the present insect as a variety, supposing that the hind legs may have been largely denuded of hair.

Centris rufulina, new species

MALE.—Length about 10.5 mm., anterior wing 9.2 mm.; head and thorax black, abdomen and legs red, the legs more or less black basally, the anterior femora black in front, the middle femora mainly black or very dark in front, but apex and

upper margin red, the hind femora with more than the basal half black or nearly so in front and behind; pubescence entirely pale, except a fuscous band on occiput; the short dense hair of thorax above is reddish fulvous, on sides of thorax it is paler, and on lower part of cheeks white; eyes red-brown; clypeus (except a broad band at each side above), a short transverse crescentic supraclypeal mark, lateral marks filling space between clypeus and eye, malar space, labrum entirely, mandibles except apex, and scape in front, all bright lemon yellow; third antennal joint red beneath, flagellum obscure reddish; tegulae clear red; wings very dilute fuliginous; hind tibiae and tarsi with long pale hair; hind trochanters unarmed; abdomen entirely clear red, except a yellow spot at each side of second tergite.

British Guiana: Waranama, Nov. 10, 1936 (L. Ogilvie). In Friesc's table of *Rhodocentris*, this runs nearest to *C. labrosa* Friesc, having the labrum not greatly broader than long, but it is not black or notched at end. Superficially, it looks just like *C. vulpecula* Burmeister, but the legs and face are quite different. Actually, it is a red derivative of the group of *C. nitens* Lepeletier, which falls in *Cyanocentris* in Friesc's arrangement. It is not a color-variety of *C. nitens*, being considerably smaller. The clypeus is flattened and polished in middle, much more shining than in male *C. nitens*.

Ceratina paraguayensis Schrottky

British Guiana: Waranama, Nov. 15, 1936 (J. Ogilvie). It differs from the type (♀) by having the antennae black, but agrees so closely with Schrottky's description of this Paraguay species that I cannot refer it elsewhere. It is closely allied to *C. chrysocephala* Cockerell, from Brazil, but differs by the yellow spot on tubercles, the blue-black mesothorax, black scape, and brassy green abdomen.

When we consider the topography of South America, it appears probable that the fauna of Paraguay may more closely resemble that of the lowlands of British Guiana than does that of the eastern coast of Brazil, as at Rio de Janeiro. The coastal lowlands form a narrow strip, cut off from the interior by the vast plateau of Brazil. But from the valley of the Paraná and Paraguay the lowland humid forest extends northward through western Brazil and the broad valley of the Amazon, and is connected with British Guiana by way of the Rio Branco.

Eulaema polyzona Mocsary

British Guiana: Waranama, Nov. 16 and 20, 1936 (J. Ogilvie).

AMERICAN MUSEUM NOVITATES

Number 929

Published by
THE AMERICAN MUSEUM OF NATURAL HISTORY
New York City

June 11, 1937

RECORDS OF AFRICAN BEES

By T. D. A. COCKERELL

The holotypes of the new forms will be found in The American Museum of Natural History.

Halictus albofasciatus Smith

Orange Free State: Donkerpoort, April (L. Ogilvie, J. Ogilvie); North Bank Halt, Norvals Pont, April (J. Ogilvie, L. Ogilvie).

Halictus dispilurus, new species

FEMALE.—Length about 5.6 mm., anterior wing about 4 mm.; head and thorax black, the head, mesothorax and scutellum brilliantly shining, but the very large area of metathorax, which is rounded behind, entirely dull; head and thorax with scanty pale hair, very thin on face, almost lacking on thoracic dorsum (no trace of bands in the sutures), but long and fairly abundant on pleura; head broader than long, inner orbits concave; supraclypeal area prominent, polished; clypeus very short, shining, with sparse punctures; mandibles dusky reddish; flagellum red beneath except at base; front dullish, shining at extreme sides; mesothorax very finely punctured, with a strong median groove; posterior face of metathorax dull; tegulae brown, dark in front; wings grayish hyaline, with rosy and green iridescence; stigma large, light yellowish brown; second cubital cell about square; legs black, with the tarsi pale red; abdomen stout, without hair-bands or spots; first tergite brown, blackened basally, and with a large black spot on each side; second tergite red, with a pair of very large black marks, pointed mesad; fourth and following tergites black, with pallid margins.

Microscopical characters: mesothorax very minutely lineolate, with very sparse piliferous punctures; area of metathorax extremely densely rugulose, with the appearance of bead-work, all over, and with weak plicae on basal part; hind spur minutely spinulose, after the manner of *H. platti* Cockerell.

Natal: The Bluff, Durban, Oct. 15, 1931 (L. Ogilvie). Related to *H. platti*, *H. pondonis*, etc., running in the table in African Bees, p. 76, to the group of *H. probitus*, *H. calvini* and *H. villosicaudus*, but distinguished by the marking of the abdomen. *H. probitus* is larger, with the area of metathorax relatively short, crescentic. *H. calvini* and *H. villosicaudus* have the mesothorax dullish.

Halictus duponti Vachal

Tanganyika Territory: Kigoma, Aug. 31 (J. Ogilvie). Kabalo, Belgian Congo, Aug. 15 (A. Mackie).

***Halictus pachyurus*, new species**

FEMALE.—Length about 9 mm., anterior wing 7 mm., abdomen broad, its width about 3.5 mm.; black, including mandibles and antennae, but the tarsi rather dark red, the front basitarsi blackened; tegulae black, a little reddish posteriorly; wings grayish hyaline, stigma and nervures rather pale reddish, outer nervures (recurrent and intercubitus) thin and very pale; face and cheeks with white hair, but pale reddish hair on vertex, and red hair on labrum; thorax above with pale reddish hair, metathorax and pleura with white; legs with dull white hair, pale yellowish on inner side of basitarsi; the middle tibiae are red at apex; the hind basitarsi have a shining very red area at extreme base, and a copper-red brush at apex; the broad abdomen is shining, the first tergite very narrowly reddened apically, the second and third with broad red apical tegumentary bands, the fourth with the margin pallid; the basal bands of tomentum are fulvescent, apparent only at sides of second tergite, on third and fourth probably entire, but concealed in middle; venter with long white hair. Head approximately circular seen from in front; a tooth at each side of clypeal margin; apical part of clypeus shining, but the upper part very densely and finely punctured; supraclypeal area densely punctured, with a shining spot in middle; front dull except at extreme sides; vertex shining; mesothorax very finely punctured, shining on disk, distinctly glaucous; scutellum dull, depressed in middle; red hair in middle of postscutellum; area of metathorax short, with very fine punctiferous plicae and a shining ridge in middle; second cubital cell very broad, receiving recurrent nervure not far from end; third cubital not much broader than second; hind spur with nine short oblique but strong spines.

Belgian Congo: Tenke, July 30–Aug. 9 (J. Ogilvie). In many respects this resembles *H. matoporum kafubuensis* Cockerell, and the sculpture of the clypeus, with fine dense punctures on upper part, associates it with this species, and separates it from the various forms of *H. shanganiensis* Cockerell. Yet the red abdominal bands at once separate it from these forms, and place it in another group. These bands also separate it from *H. aureotarsis* Friese, which has reddish-yellow tarsi. *H. rhodaspis* Cockerell, from Natal, agrees in having the red hair in middle of postscutellum, but it has black tarsi, and no red tegumentary bands on abdomen. *H. pulchricinctus* Cockerell has orange bands on the first two tergites, and the wings reddened.

A new record for *H. matoporum kafubuensis* is Elisabethville (J. Ogilvie).

HALICTUS SUBGENUS CHLORALICTUS (ROBERTSON)***Halictus (Chloralictus) angustulus*, new species**

FEMALE.—Length about 5 mm., anterior wing 3.8 mm.; slender, looking rather like a male, with little hair, and no bands or spots of hair on abdomen; upper part of head, the mesothorax and scutellum, dark green, not brassy, the other parts of head and thorax black or almost so, the clypeus except the upper end black, with coarse sculpture; mandibles red with the base black; head small and short, the clypeus and upper part of front shining, the middle ocellus little in advance of the

others; upper part of cheeks shining; flagellum pale dull reddish beneath except at base; mesothorax and scutellum moderately shining, the median groove of mesothorax distinct; area of metathorax large, semicircular, dull, the rim not distinctly shining; posterior truncation small and dull; sides of thorax dull, with a shining spot beneath the wings; tegulae rufous, dark in front; wings grayish hyaline, more dusky apically; stigma dusky sepia-brown, nervures pale brown, the outer ones fairly distinct; second cubital cell rather narrow, receiving recurrent nervure a moderate distance from end; legs black, the tarsi somewhat brownish; abdomen shining, distinctly greenish, the sutural regions reddish. Microscopic characters: clypeus very coarsely punctured; mesothorax transversely lineolate, and with extremely small, scattered punctures; area of metathorax very minutely pitted all over, with short very weak plicae at base; hind spur with long oblique spines as in related species.

Belgian Congo (Katanga); Biano, Aug. 8-11, 1931, 3 females (J. Ogilvie). Related to *H. chloronotus* Cockerell, which is more robust, with more shining, more brassy-green mesothorax, and a much larger head, with broader face.

Halictus (Chloralictus) chloronotus, new species

FEMALE (type).—Length about 5 mm., anterior wing 4 mm.; head and thorax dark green; abdomen very dark brown, almost black, the two basal tergites with a faint suggestion of greenish; head approximately circular seen from in front; antennae black; clypeus with the apical half black; front dull at sides, but shining just below ocelli; mesothorax moderately shining, rather yellowish green, excessively finely punctured, and with a median groove; scutellum dullish; area of metathorax black, semicircular, entirely dull, as seen from above with no shining margin, the surface minutely rugulose, the base and sides with weak plicae, only visible under the microscope, posterior truncation dull and black; mesopleura and sides of metathorax faintly bluish green; tegulae very dark brown, with scattered indistinct punctures; mesothorax under microscope showing a finely lineolate surface, with sparse punctures; wings dusky, stigma and nervures brown; second cubital cell narrowed above, its lower and outer sides about equal; legs very dark brown, with dull whitish hair; hind spur with a very thick base, and three long oblique spines, the first two very long, and a rudimentary fourth spine, hardly visible and not always present, tip of spur curved; abdomen shining, without bands or spots of hair, but the apex with thin pale hair. Two specimens, with more projecting clypeus, the head thus appearing more elongated, were at first set aside as distinct, but I cannot satisfactorily separate them.

MALE.—Clypeus with no light mark; antennae long, black; mesothorax and scutellum shining, brassy-green; legs without light markings; abdomen distinctly greenish.

Belgian Congo: Tshibinda, August 21-27, 14 females, 10 males (J. Ogilvie, L. Ogilvie, A. Mackie, Cockerell). The following table separates the male from some similar ones, which have been recorded from Africa:

- 1.—Clypeus with a light mark; flagellum yellowish red beneath...*morio* Fabricius.
Clypeus with no light mark.....2.
- 2.—Larger; flagellum mainly red beneath; abdomen strongly metallic.
smeathmanellus Kirby.
Smaller; flagellum black.....3.
- 3.—Wings clear; sternites with brown margins (Abyssinia).....*meneliki* Friesse.
Wings dusky; sternites without brown margins....*chloronotus*, new species.

I have examined *H. meneliki*, a specimen being in The American Museum. Only the male is known. The female *H. chloronotus* resembles *H. morio*, but the area of metathorax is much larger and quite different, the stigma quite differently colored, etc.

H. centrosus Vachal, female, is larger (6.5 mm.), with head, thorax and first tergite green, the rest of the abdomen black or dark brown. The wings are yellowish, with reddish nervures. The locality (Kalumbaba) is, I believe, in N. Rhodesia.

Halictus (Chloralictus) zimbabwicus, new species

FEMALE (type).—Length about 5 mm., anterior wing 4 mm.; head, thorax and the broad abdomen green; antennae black, the flagellum faintly brown beneath at end; legs black; tegulae black or nearly so; wings rather dusky hyaline; stigma large, rather light reddish brown, nervures pale. Head approximately round seen from in front, the clypeus moderately projecting; mandibles black; clypeus with the apical half black; face on each side of antennae blue-green, rather shining; front dull; mesothorax and scutellum dark bluish green, dullish, the mesothorax microscopically tessellate and lineolate, with very sparse weak punctures; area of metathorax large, semicircular, dull, with a shining edge, the surface densely microscopically pitted, with weak radiating plicae, at middle as well as sides, not reaching margin, and only seen under microscope; posterior truncation green, moderately shining; second cubital cell narrowed above, the lower side not as long as the outer; legs with pale hair; hind spur with two long oblique spines, and a minute serrulation on apical part, the apex of spur not hooked; abdomen blue-green, polished and shining, the margin of the second tergite brown, of the third and fourth pallid; apex with white hair.

MALE.—Length about 5 mm., anterior wing 3.5 mm.; slender, with narrow abdomen and very long antennae; dark bluish green, the mesothorax, scutellum and supraclypeal region more yellowish green, the shining, almost brassy scutellum contrasting with the dark blue metathorax; pubescence very scanty, abdomen without hair-bands; head broad, clypeus moderately produced, green, distinctly punctured; no light mark on clypeus, and mandibles entirely dark; supraclypeal area shining, but front dull, except a small brilliantly shining spot just in front of middle ocellus; flagellum very obscurely brownish beneath; metathorax and sides of thorax dark blue-green, the area of metathorax semicircular, dull, densely pitted, with no shining margin, but with irregular long plicae from the base; mesothorax shining, the median groove indistinct or incomplete; tegulae very dark brown, punctured; wings rather dusky hyaline, darker apically; stigma rather light brown, with a darker margin;

nervures pale brown, outer ones distinct; legs black, the tarsi a little reddish; abdomen slender, shining dark green.

Southern Rhodesia: Zimbabwe, Sept. 30, 1931 (Alice Mackie). By the metathoracic area this is related to *H. chloronotus* Ckll., but the hind spur and abdomen are quite different. There are more kinds of small green *Halictus* in South Africa than the books describe. *H. atroviridis* Cameron (type examined in British Museum, in very bad state) has the mandibles red, black apically, mesothorax finely and closely but distinctly punctured, hind margins of tergites rufous. Three other species in the British Museum bear manuscript names by Cameron, but they are all quite different from *H. zimbabwicus*.

Other specimens come from Vumba (or Vumbu), Umtali, May 23-26, 1932, 1 female, 3 males (J. Ogilvie, L. Ogilvie).

The male much resembles *H. angustulus* from Bianco, but is more robust, more brassy-green, with green clypeus. Compared with *H. chloronotus* it is conspicuously smaller, with much smaller head. The male *H. chloronotus* has tufts of hair at sides of fifth sternite, lacking in *H. zimbabwicus*. These little bees seem to form a group in the African fauna, analogous to that of *H. regularis* Robertson in the fauna of America.

The following key will be found useful:

- 1.—Males 2.
 Females 3.
- 2.—Mesothorax brassy-green, abdomen not bluish *chloronotus*.
 Mesothorax bluish-green, abdomen bluish *zimbabwicus*.
- 3.—Abdomen strongly green *zimbabwicus*.
 Abdomen not or hardly metallic *chloronotus* and *angustulus*.

HALICTUS SUBGENUS HOMALICTUS COCKERELL

Halictus (*Homalictus*) *radiatulus*, new species

MALE.—Length about 5.7 mm., anterior wing 4.7 mm.; robust, green, with short antennae like those of a female (compare *H. pinnatus* Vachal, which is, however, a black species), and thin white pubescence, forming dense bands at bases of fourth and fifth tergites; head broad, the orbits converging below; mandibles pale yellow, subapically red, and black at tip; labrum yellow; clypeus with a broad apical pale yellow band, having an angular extension above in middle line; green portion of clypeus, and middle of front above antennae, shining; a polished spot laterad of each lateral ocellus; antennae black, the flagellum obscurely reddish beneath; third antennal joint red beneath, contrasting with the black second; thorax above conspicuously pilose, the hair in region of scutellum long; thorax golden green, the mesothorax dull and dark, with a very densely punctured surface; scutellum shining, obtusely bigibbous; area of metathorax large, glistening, with very strong radiating plicae, and in apical middle with a confused sculpture of partly transverse plicae;

tubercles with a small yellow spot; tegulae pale testaceous; wings very clear hyaline, stigma and nervures pale yellowish, outer recurrent and intercubitus invisible under a lens; legs green at base, but knees broadly, tibiae and tarsi, pale yellow, the tibiae stained with pale red; abdomen broad, shining, margins of tergites slightly brownish, not pallid, apical plate broad and dark; sternites with conspicuous hair-bands; the green of the abdomen is similar to that of the thorax.

Belgian Congo: Tshibinda, Aug. 21-27, 1931 (L. Ogilvie); also one from south of Bukavu, Aug. 28 (Alice Mackie). Among the African species nearest to *H. duponti* Vachal, which has a similarly sculptured metathorax, but has a red scape and entirely red legs. The marginal nervure is conspicuously darker than in *H. duponti*. According to definition, this falls in the subgenus *Homalictus* Cockerell (Philippine Jour. Sci., XV, July, 1919, p. 13), but whether it really belongs to this Oriental group, or to an independently-evolved African one simulating it, must remain somewhat uncertain.

HALICTUS SUBGENUS SELADONIA ROBERTSON

Halictus (*Seladonia*) *atroviridis* Cameron

I examined the type (in very bad state) in the British Museum, and noted: head relatively (as compared with *H. jucundus*) rather narrow, the orbits converging below; mandibles red, black apically; mesothorax finely and closely but distinctly punctured; hind margins of tergites rufous. One of Cameron's specimens is *H. jucundus* Smith.

Meade-Waldo considered *H. aethiopicus* Cameron to be the same, but this is not the case. I examined the type, and noted the black mesothorax; legs bright clear red except at base; hind margins of tergites broadly pale yellowish, broadest in middle; wings very clear, stigma and nervures very pale. Size of ordinary *Evylaeus*.

Halictus (*Seladonia*) *austrovagans* Cockerell

Cape Province: Ceres, Feb. 12-18 (A. Mackie, J. Ogilvie); Graaff-Reinet, Oct. 21-27 (J. Ogilvie, A. Mackie); Huguenot, Feb. (J. Ogilvie).

Halictus (*Seladonia*) *banalianus* Strand

Belgian Congo: Uvira, Aug. 28-29 (J. Ogilvie). This species is more robust than *H. hotoni* Vachal, with the dorsal hair of head and thorax pale ferruginous. Yet on examining a long series from localities in Katanga there is apparent a good deal of variation, and the insect seems to grade into *H. hotoni*. The original *H. hotoni* came from Delagoa Bay, and I have seen the type, but it is not known whether it varies toward *H. banalianus* in that locality. From Victoria Falls I have both

H. banalianus and *H. hotoni*, as I have determined them. A specimen from the Matopo Hills, S. Rhodesia (J. Ogilvie), is *H. hotoni*. I have females of *H. hotoni* from Greytown, Natal (A. Mackie), and Graaff-Reinet, C. P. (J. Ogilvie).

***Halictus (Seladonia) capensis* Friese**

From Blaukrans, near Calvinia, C. P. (Cockerell) and Calvinia (J. Ogilvie) come males which are readily separated from *H. austrovagans*, common in the same region, by the larger size and blue-green color. Hair of head and thorax abundant and pure white; labrum, greater part of mandibles and narrow margin of clypeus light yellow; flagellum long, clear yellow or orange beneath; wings very clear, milky, stigma very pale orange-tinted; knees, tibiae and tarsi light yellow, except that the middle and hind tibiae are mainly dark in middle; abdomen shining. This insect is evidently the male of *H. capensis*; I have a female of that species from Calvinia (J. Ogilvie).

There is also a male *H. capensis* from Windhoek, S.W. Africa, Dec. 12, 1933 (L. Ogilvie).

***Halictus (Seladonia) jucundus* Smith**

The typical *H. jucundus*, with fulvous hair on thorax above, and fulvescent abdominal bands, was collected in great numbers by Mr. and Mrs. Ogilvie at Bot River, Cape Province, Nov. 10, 1933. They also got three at Cape Town, on Lion's Head, Oct. 29, and three at Kirstenbosch, Nov. 10 and 18. A female from North Bank Halt, Norvals Pont, Orange Free State (L. Ogilvie), is typical as to color of hair, but the area of metathorax is rather more distinctly sculptured, and more pointed. One from the Matopo Hills, S. Rhodesia (A. Mackie), is rather small, with strongly fulvescent hair. Smith gives the type localities as "Cape; Sierra Leone." The Cape is now designated as the type locality; presumably the vicinity of Cape Town.

Females from Doorn River Falls, near Nieuwoudtville (J. Ogilvie, A. Mackie, J. Jooste) are rather small, with the hair of thorax above and abdominal bands grayish white, and the area of metathorax more pointed behind. They represent a weak local race, but I hesitate to offer a name for it, as it is not sharply defined and one specimen from the same locality has the pubescence distinctly fulvescent. Females approaching or belonging to this race are from Bosrand, Afdeling Farm, Orange Free State (J. Ogilvie); Upington, C. P. (J. Ogilvie, L. Ogilvie); Nelspoort, C. P. (J. Ogilvie); Windhoek, S.W. Africa (J. Ogilvie).

***Halictus (Seladonia) pruinescens*, new species**

FEMALE.—Length about 6.5 mm., anterior wing 4.5 mm. Head and thorax bluish green, abdomen black with a faint green tinge, the first tergite green; hair of head and thorax dull white, rather abundant; head broad, face very broad, cheeks rounded, ordinary; mandibles with a conspicuous red subapical mark; clypeus shining, sparsely but strongly punctured, the lower half black; front and vertex dull, no shining spot laterad of ocelli, but a shining line along orbits at upper end; flagellum red beneath except at base; mesothorax dull, closely but distinctly punctured; scutellum more shining, distinctly bigibbous; area of metathorax crescentic, with a finely wrinkled surface; sides of thorax hairy, the green color obscure; posterior truncation of mesothorax brilliantly shining; tegulae dark brown, with a pale spot in middle; wings dusky hyaline, stigma very pale, nervures pale; legs black, the middle knees with a red spot, and the tarsi reddish; tergites with pallid margins, on which are whitish hair-bands, not always very distinct, there are also the usual bands at extreme bases of tergites; surface of third and following tergites with thin whitish hair; apex with white hair. The hind spur has four strong oblique spines.

Cape Province: Ceres, Feb. 12–18, 1932 (J. Ogilvie, L. Ogilvie, A. Mackie). Eight females. *H. vansoni* Cockerell differs by the longer head with narrower face, and clear testaceous tegulae; *H. diductus* Cockerell by the much larger area of metathorax, appearing granular all over, and the yellowish hair of scutellum; *H. capensis* Friese by the shining mesothorax and blue-green abdomen. *H. banalianus* Strand, a robust green species with reddish hair on head and thorax above, hardly needs to be compared. It is a common species of the eastern part of the Belgian Congo, but to my surprise I find a female *H. banalianus* from as far south as Ficksburg, Orange Free State (J. Ogilvie).

***Halictus (Seladonia) seminiger*, new species**

FEMALE.—Length about 6.5 mm., anterior wing 5 mm.; head and thorax dark green, abdomen black, including first tergite; hair of face, cheeks and sides of thorax white, of thorax above slightly brownish; head broader than thorax, face very broad, cheeks rounded, hairy; mandibles red subapically; clypeus black, with the upper end green; supraclypeal area green, shining; front and sides of face dull, a small shining spot at each side of the ocelli; antennae black, with the flagellum obscurely brownish beneath; mesothorax and scutellum olive-green, shining; area of metathorax very large, without a shining rim, appearing dull and granular under a lens; tegulae ferruginous, dark in front; wings hyaline, somewhat yellowish, stigma and nervures pale amber; second cubital cell receiving first recurrent nervure very near end; femora and base of legs black, but knees, anterior tibiae, middle and hind tibiae except a large black mark, and all the tarsi except a dusky stain on hind basitarsi, bright ferruginous; abdomen broad, moderately shining, the tergites with grayish apical bands, and more or less evident basal bands on second to fourth; caudal fimbria yellowish. Microscopic characters: mesothorax and scutellum strongly punctured; area of metathorax densely covered with fine wrinkled rugae; hind spur with

four long oblique spines. The pollen grains collected are spherical and pale yellow, apparently of some species of Compositae.

Belgian Congo (Katanga): Dilolo (type locality), July 24-27, 1931 (J. Ogilvie); Tenke, July 30-Aug. 9 (Cockerell); Elisabethville, Sept. 11-17 (J. Ogilvie). Near Kasai River, Angola, July 25 (J. Ogilvie). Related to *H. hotoni* Vachal, but easily separated by the black abdomen. *H. valligenis* Cockerell has a black abdomen, but is much larger, with a quite different head.

Nomioides maculiventris Cameron, variety **cyaneonotus**, new variety

There is a variety of the male of *N. maculiventris* which runs in Blüthgen's table (Stett. Ent. Zeit., 1925, LXXXVI, p. 95) straight to *N. halictoides* Blüthgen. But it is easily known from Blüthgen's species by the less hairy face, the scape yellow in front, the longer and more slender antennae, and the largely black hind tibiae. In *N. halictoides* the scape is all black, and the hind tibiae are entirely pale yellow. In a later paper (Stett. Ent. Zeit., 1934, XCV, p. 251) Blüthgen has given the contrasting characters of the males of the two species, but the variety now described has the clypeal yellow reduced as in *N. halictoides*, and the abdomen without light markings. *N. halictoides vernayi* Cockerell and Ireland has a yellow stripe on the scape in front, but goes with *N. halictoides*, certainly not with *N. maculiventris*. I give the variety of *N. maculiventris* a name, as it appears very distinct from the typical form, but I do not think it is a subspecies. I find I had mistakenly referred a specimen from Blaukrans to *N. halictoides*.

MALE.—Length about 4 mm., anterior wing 2.7 mm.; head and thorax rich purple-blue, abdomen black, legs with basal parts including femora black, and a large black saddle on hind tibiae, sometimes including the whole tibia except ends, but the knees, tibiae (except as stated) and tarsi light yellow; the scanty pubescence white. Head broad, approximately circular seen from in front; face and lower part of front hoary with white hair; supraclypeal area convex, shining black, contrasting with the blue sides of face; upper part of clypeus black; labrum, mandibles and lower margin of clypeus light yellow; antennae long; scape yellow in front, flagellum dark brown above, pale reddish or clay color below; mesothorax finely punctured, moderately shining, but not polished; scutellum with a conspicuously shining median line; area of metathorax large, dull, with the apex shining; tegulae with a large pale spot; wings perfectly hyaline, iridescent, with pink and green tints, stigma slightly yellowish, with a darker margin, nervures colorless; abdomen rather broad, black, the margins of the tergites somewhat pallid; no hair-bands or spots. Under the microscope the area of metathorax is seen to be finely pitted or punctured all over, on the apical part the punctures running in transverse lines; at the base of the area are some short irregular plicae. The second cubital cell is much narrowed above, and the first recurrent nervure meets the second intercubitus.

Cape Province: Graaff-Reinet (type locality), Oct., 1931, 2 males (Alice Mackie, J. Ogilvie); Calvinia, Nov. 1931, 3 males (J. Ogilvie); Blaukrans, near Calvinia, 1 male (Cockerell).

Nothylaeus binotatus (Alfken)

Belgian Congo: Elisabethville (J. and M. Bequaert). Three females, varying in the amount of red, and the size of the light spots on scutellum, these being in one specimen reduced to minute dots.

Ceratina ericia bukavana (Cockerell)

Belgian Congo: Kabinda, 3♂, 4♀ (J. Bequaert). All the females at flowers of *Vernonia* No. 50. They have the light bar on clypeus unusually small. Females of *C. geigeriae* Cockerell were also taken at Kabinda, but not on the *Vernonia*.

Ceratina nitidella, new species

MALE (type).—Length 4 mm. or slightly over; shining black, the head and mesothorax highly polished; the clypeus with a reversed T in white, the stem very thick, the upper end truncate, the lateral extensions cuneiform; labrum with a round white spot, narrowly separated from clypeus; mandibles and antennae black; scutellum dullish, only a little shining; base of metathorax dull; tubercles with a white spot; tegulae brown; wings dusky hyaline, with brilliant rosy and green iridescence; nervures dark; second cubital cell large, triangular; stigma large, very dark brown; tarsi and anterior tibiae rufous; abdomen moderately shining, the tergites not fimbriate.

FEMALE.—Similar to the male, but clypeus with a broad white bar, obtusely rounded above, with a little extension on each side below; labrum all black, with a small shining pit; tubercles white-spotted as in female; legs darker.

Liberia: Du River, Camp No. 3 (J. Bequaert). There are two small species, described by Strand, from the Cameroons. *C. ludwigsi* Strand, female, is easily separated by the light brownish-yellow labrum, and the mandibles light brownish yellow with black end. *C. foveifera* Strand is known by the clear reddish clypeus and red-brown mandibles. A nearer relative appears to be the S. African *C. liliputana* Brauns, which is distinctly smaller, with a much smaller, pale, stigma, pale nervures, more slender marginal cell, first recurrent nervure joining cubital cell much nearer end.

Thrinchostoma malelanum, new species

FEMALE.—Nearly agrees with the description of *T. wellmani* Cockerell, but compared with the type of that species evidently distinct by the following characters: Third and fourth tergites with silvery-white hair on disk, and some black hair at base; first recurrent nervure reaching base of third cubital cell; abdomen broader..... *wellmani* Cockerell.

Third and fourth tergites with abundant black hair on disk, and silvery only on apical depression; first recurrent nervure meeting second intercubitus; abdomen narrower. *malelanum*, new species.

Length about 13 mm., anterior wing 9.2 mm., length of head about 3.5 mm.; black, including antennae (flagellum faintly reddish beneath) and legs (tarsi obscurely reddish apically); hair of head and thorax white, black hair on scutellum; clypeus convex, polished, with an apical triangular region which is very coarsely punctured; malar space a little longer than broad; flagellum with modified areas on the last four joints; prothorax with grayish-white hair, the fringe of tubercles dense, and a similar dense band just behind tubercles; mesothorax dull, finely punctured, without conspicuous hair, except a band of light hair along hind margin; scutellum dull, with a shining area in middle; area of metathorax rugose, the microscope shows vermiform rugae; tegulae dark brown, pallid anteriorly; wings ample, hyaline, slightly grayish (not reddish), the outer margins dusky; stigma dusky red, nervures brown; basal nervure falling considerably short of nervulus; second cubital cell nearly square, but broader than high, its pubescence not differing from that of other cells; first recurrent nervure meeting second intercubitus; third cubital cell considerably longer than in Blüthgen's figure of *T. torridum* Smith; legs with pale hair, dark, somewhat reddish, on inner side of hind tarsi; abdomen rather narrow, apical margins of first four tergites depressed, pallid, with silvery hair; base of first tergite with long white hair, disks of third and fourth with long black hair; apex with black hair.

Belgian Congo: Pangula, near Malela, "Vill. Malela, (Chief Kasende), 5° 40' S., 23° 45' E." (J. Bequaert). It is also related to *T. patricium* (Strand), which is smaller (11 mm.), with brownish abdomen, and the hair on inner side of hind tarsi clear yellow.

***Thrinchostoma torridum* (Smith)**

Tanganyika Territory: Kilossa (or Kilosa), alt. 1950 ft., male, March 20, 1922 (Loveridge).

***Morgania nigripes* (Friese)**

Specimens from Mlanje, Nyasaland (Neave) and Blantyre (J. B. Davey), recorded as *M. fortis* Cockerell, really belong to *M. nigripes*. Bischoff's statement, "flügel klar," is misleading; the wings are dilute fuliginous.

***Crocisaspidia nigripes* (Friese)**

Belgian Congo: Luputa, Dist. Lomami (J. Bequaert).

***Eucara laticeps* (Friese)**

Belgian Congo (Katanga): Elisabethville (J. Bequaert).

***Gronoceras bombiformis* (Gerstaecker)**

Belgian Congo: Kabinda (J. Bequaert).

Gronoceras cerberus (Fries)

S.W. Africa: Windhoek, Dec. 14 (J. Ogilvie).

Gronoceras felina (Gerstaecker)

Bechuanaland: Palapye Road, March 4 and 5 (L. Ogilvie, J. Ogilvie).

Gronoceras holorhodura Cockerell

Belgian Congo: Kabinda, 6° 8' S., 24° 21' E. (J. Bequaert).

Megachile pennata Smith

Cape Province: Upington, Dec. 7 (J. Ogilvie); Mafeking, Feb. (L. Ogilvie, J. Ogilvie).

S.W. Africa: Okahandja, Jan. 23 (J. Ogilvie).

Megachile rufipes (Fabricius)

Belgian Congo: Kabinda, nest in beam of house (J. Bequaert).

Variety *xanthoptera* (Schletterer), Luputa (J. Bequaert).

Trigona bocandei Spinola

Belgian Congo: Luputa (J. Bequaert).

Trigona cameroonensis Fries

Belgian Congo: Kabinda (J. Bequaert); Vill. Malela (Chief Kasse) (J. Bequaert).

Trigona staudingeri Gribodo

Belgian Congo: Kabinda (J. Bequaert).

Trigona togoensis Stadelmann

Belgian Congo: Kabinda, at flowers of cultivated coffee (J. Bequaert).

AMERICAN MUSEUM NOVITATES

Number 930

Published by
THE AMERICAN MUSEUM OF NATURAL HISTORY
New York City

June 24, 1937

STUDIES OF PERUVIAN BIRDS. NO. XXVI ¹

NOTES ON THE GENERA *AGRIORNIS*, *MUSCISAXICOLA*,
MYIOTHERETES, *OCHTHOECA*, *COLONIA*, *KNIPOLEGUS*,
PHAEOTRICCUS, *FLUVICOLA*, AND *RAMPHOTRIGON*

BY JOHN T. ZIMMER

I am greatly indebted to Mr. W. E. C. Todd of the Carnegie Museum, Pittsburgh, for permission to examine certain material in the collection under his charge. I am also grateful to Mr. J. D. Macdonald of the British Museum for the critical identification of a Peruvian specimen in that institution.

Names of colors are capitalized when direct comparison has been made with Ridgway's 'Color Standards and Color Nomenclature.'

Agriornis microptera andecola (D'Orbigny)

Pepoaza andecola D'ORBIGNY, 1840, 'Voy. Amér. Mérid.,' Oiseaux, p. 351—"sur les parties les plus élevées du plateau des Andes" = Bolivia; Paris Mus.

Agriornis andecola paznae MÉNÉGAUX, 1909 (Jan.), Bull. Mus. Hist. Nat. Paris, XIV, p. 340—road from Pazña to Urmiri, near Lake Poopo, Oruro, Bolivia; Paris Mus.

Puno, 1 "♂," 1 ♀; Tirapata, 1 ♂.

The species has not been recorded heretofore from Perú, but probably is a regular winter visitor to the highlands in the neighborhood of Lake Titicaca.

These birds agree well with several others from northern Bolivia in respect to the browner and less pronounced streaking on the throat which, in turn, is less purely white than in the average of a dozen birds from Argentina. Also, the general color of the body is more buffy and less grayish than in the Argentine specimens. I cannot, however, find any difference in the comparative slenderness of the bill in birds from the two regions, even when only selected specimens are compared.

Two adult males from Cuchacancha, Bolivia, are not very different from the adult Argentine males although the general color is slightly more buffy in hue and the streaks on the throat are somewhat less clearly blackish, having a faint trace of brown.

¹ Previous papers in this series comprise American Museum Novitates, Nos. 500, 509, 523, 524, 538, 545, 558, 584, 646, 647, 668, 703, 728, 753, 756, 757, 785, 819, 860, 861, 862, 889, 893, 894, and 917.

Three adult females from Guaqui, Cuchacancha and Vinto, Bolivia, are not clearly distinguishable from four adult females from Tucumán, Argentina. Two young males (first annual plumage ?) from Cuchacancha, Bolivia, and Puno, Perú, are decidedly less strongly marked on the throat and more buffy on the belly than two birds in comparable plumage from Tucumán, but a young male from Salta, Argentina, is a good match for the Puno specimen and one from San Antonio de los Cobres, Province of Los Andes, is ochraceous below and very lightly marked on the throat. A young female from Tirapata, Perú, is similarly matched by one from the Province of Salta.

The most satisfactory arrangement of the material in hand places the birds from the provinces of Salta and Los Andes with the Bolivian and Peruvian series of *andecola* while the Tucumán examples presumably represent the southern form, *microptera*, which is said to be only a winter visitor in that region. The status of *andecola* in extreme northern Argentina and, for that matter, in southeastern Perú has yet to be determined, but it is probable that it breeds throughout its entire range. The young male from San Antonio de los Cobres is in its post-juvenal molt.

SPECIMENS EXAMINED

A. m. microptera.—ARGENTINA: Tucumán, 2 ♂, 2 ♀; Manchala, 1 ♀; Salto, 1 ♀; Tafi del Valle, 1 ♂; Angaco Sud, 1 ♂; Santiago del Estero, 1 ♂.

A. m. andecola.—ARGENTINA: Cachi, Prov. Salta, 1 ♂, 1 ♀; San Antonio de los Cobres, 1 ♂. BOLIVIA: Cuchacancha, 3 ♂, 1 ♀; Vinto, 1 ♀; Guaqui, 1 ♀. PERÚ: Puno, 1 ♂, 1 ♀; Tirapata, 1 ♀.

Agriornis andicola albicauda (Philippi and Landbeck)

Dasycephala albicauda PHILIPPI AND LANDBECK, 1863, Arch. Naturg., XXIX (1), p. 132—one of the valleys of the cordilleras of Perú = Prov. Tacna, Chile (type said to be labeled "Arica"); Chilean Nat. Mus., Santiago.

Comparison of ten Peruvian specimens with six Ecuadorian birds shows an appreciable difference in the two series. Ecuadorian birds are larger [adult males: wing, 145 (badly worn)–151 mm.; tail, 120 (badly worn, 114); tarsus, 42–43.25; females and young males: wing, 135–140.5; tail, 112–115; tarsus, 39.25–43]. Peruvian specimens are smaller [adult males: wing, 136–146; tail, 108–117.5; tarsus, 39–40; females and young males: wing, 130–136, tail, 100–110; tarsus 36.5–40]. I have included the measurements of one Chilean and three Peruvian birds in the collection of Field Museum of Natural History, Chicago.

In addition, the Ecuadorian birds are darker in color on the whole upper surface and on the breast and sides, and the females and young males have the breast more prominently streaked. So far as I can ob-

serve, there is no difference in the marking of the tail. A single specimen from above Tafi del Valle, Argentina, differs from all of the others by the possession of very extensive dusky brown bases on all of the rectrices. Attention has already been called to this bird by Chapman (1926, Bull. Amer. Mus. Nat. Hist., LV, p. 471). More material from northern Argentina is needed to determine the status of the resident form which, if like the specimen in hand, certainly should be separated from the Ecuadorian and Peruvian birds.

In any case, the differences shown by the skins from Perú and Ecuador are sufficient to warrant the separation of two subspecies in these two respective regions. The name *andicola* is available for the Ecuadorian form and, since this name is the oldest in the species, it must become the specific name. According to the International Rules it is not invalidated by the earlier "*andecola*" which is in use in the *montana* group and hence, in spite of the unfortunate similarity, it is not entitled to be dropped in favor of "*pollens*" which otherwise would be available for the Ecuadorian form.

Records are from Cachupata and Lucre.

SPECIMENS EXAMINED

A. a. andicola.—ECUADOR: Bestion, 2 ♂, 1 ♀; Antisana, 1 ♂; Quito, 1 ♂; Cumbaya, 1 ♂.

A. a. albicauda.—PERÚ: La Raya, 1 ♀, 1 (?) ; Rumicruz, 3 ♂, 1 ♀; Tulpo, 2 ♂; Huamachuco, 1 ♂; Cajamarca, 1 ♀; 1 ♀¹; La Quinua, 1 ♂¹; mountains near Otuzco, 1 ♂¹. CHILE: Putre, Tacna, 1 ♂¹.

A. a. subspecies?: ARGENTINA: above Tafi del Valle, 1 ♀.

Muscisaxicola rufivertex pallidiceps Hellmayr

Muscisaxicola rufivertex pallidiceps HELLMAYR, 1927 (April 11), Field Mus. Nat. Hist. Publ., Zool. Ser., XIII (5), p. 21—twenty miles east of San Pedro, Antofagasta, Chile; ♂; Field Mus. Nat. Hist.

Five specimens from Arequipa and one from Moquegua belong without question to this pale-capped subspecies. There has been no definite record of this form from Perú although Taczanowski's record of "*rufivertex*" from Arequipa rather certainly belongs here.

One specimen from Cuchacancha, Bolivia, also belongs to *pallidiceps* although eleven other specimens from the same locality are *occipitalis*. The specimens were all taken in June and there is little doubt that the individual belonging to *pallidiceps* was a migrant from the south. The Arequipa and Moquegua birds also were taken in June and it is possible that they, too, are merely winter visitants from the south although there

¹ Specimens in Field Museum of Natural History, Chicago

is no known conflict in ranges (as at Cuchacancha) to necessitate some such assumption or to prevent *pallidiceps* from occupying the region as a resident.

***Muscisaxicola rufivertex occipitalis* Ridgway**

Muscisaxicola occipitalis RIDGWAY, 1887 (November), Proc. U. S. Nat. Mus., X, p. 430—Lake Titicaca; U. S. Nat. Mus.

Muscisaxicola rufivertex ruficrissa CORY, 1916, Field Mus. Nat. Hist. Publ., Orn. Ser., I, p. 342—Macate, Perú; "♂" = ♀; Field Mus. Nat. Hist.

I can find no differences in color between the birds from northern Perú and those from southern Perú and northern Bolivia. Males from northern Perú appear to be smaller than those from the southern localities with the exception of a single specimen from La Raya, possibly wrongly sexed, which has the measurements of the northern examples. Females do not show the same differences and only two of six Bolivian birds of that sex are larger than the northern birds. Actual measurements are as follows:

S. Perú and Bolivia: males, wing, 111–122 mm.; tail, 73–81; females, wing, 105.5–112.75; tail, 67–72. N. Perú: males, wing, 109–113; tail, 70–74.5; females, wing, 105–108; tail, 68–72.5.

Central Peruvian birds that I have seen are all females and inconclusive except that one from La Quinua has the wing only 103 mm., therefore probably to be associated with the northern series.

It might be possible to recognize *ruficrissa* on the basis of the larger size of the males, but I should like to see this apparent distinction confirmed by additional specimens from the north before formally acknowledging the separation.

Records are from Lake Titicaca, Ocos, Calca, Urcos, Lauramarca, Lucre, Chicla, Tarma, Hacienda de Queta, Tinta, Junín, between Cacas and Palcamayo, and Cutervo.

SPECIMENS EXAMINED

M. r. rufivertex.—CHILE: Tofo, 1 ♀; Cajón del Río Blanco, 1 (?); Romero, Coquimbo, 1 ♂¹ (type of "*sanborni*"); "Chile?", 1 (?).

M. r. pallidiceps.—CHILE: twenty miles east of San Pedro, 1 ♂¹ (type). ARGENTINA: Cerro Muñoz, 1 ♂; Tilcara, 1 ♀; Chorrillo, Los Andes, 1 ♂; Cachi-pampa, Salta, 1 ♂. BOLIVIA: Cuchacancha, Cochabamba, 1 ♀. PERÚ: Arequipa, 4 ♂, 1 (?); Moquegua, 1 ♂.

M. r. occipitalis.—PERÚ: Tirapata, 1 ♂; La Raya, 1 ♂, 1 ♀; Puno, 1 ♂; Ttica-Ttica, 2 ♂, 1 (?); Oroya, 2 ♀; La Quinua, 1 ♀¹; Macate, 1 ♀¹ (type of "*ruficrissa*"); Cajamarca, 2 ♂, 1 ♀¹; Huamachuco, 1 ♂; Cajabamba, 1 ♂; San-

¹ Specimens in Field Museum of Natural History, Chicago.

tiago, 1 ♀; Tulpo, 1 (?). BOLIVIA: Cuchacancha, 7 ♂, 5 ♀; Vinto, 1 ♂. "Near Valparaíso" (errore), 1 (?).

Ochthoeca oenanthoides polionota Selater and Salvin

Ochthoeca polionota SCLATER AND SALVIN, 1870, P. Z. S. London (for 1869), p. 599—Pitumarca, Perú; British Mus.; paratype in Amer. Mus. Nat. Hist.

Specimens from northern and central Perú and from the southeastern part of the country on the northern (or eastern) side of the Andes may all be referred to *polionota*. A male from Oconeque and a female from Limbani are not quite typical. Both are a very little paler than the average and the Limbani specimen has faint traces of a pale wing-bar, while both are smaller than the average, though not outside the minimum of the series from other localities and not so small as the skins of *oenanthoides* examined.

A male from La Raya, just over the divide in the northern drainage, is as dark as any other *polionota*, but there is a well-marked wing-bar on the greater coverts, although it is dull and relatively dark cinnamonaceous instead of pale and buffy as in *oenanthoides*. These variations all point to the close approach of *oenanthoides*.

A single specimen from northern Perú (Huamachuco) is very slightly paler above than central Peruvian examples, but the difference is too slight to be of great significance.

A male from Pitumarca, once mounted and now quite faded, is noted on the original label as "type" but probably is no more than one of the paratypes since the type is said to be in the British Museum.

Records which belong to *polionota* are from Ollachea, Maraynioc, Ingapirca, Queta, Anta, and Lauramarca.

Ochthoeca oenanthoides oenanthoides (D'Orbigny and Lafresnaye)

F(luvicola) Oenanthoides D'ORBIGNY AND LAFRESNAYE, 1837, Mag. Zool., VII, cl. 2, Syn. Av., p. 60 La Paz, Bolivia; Paris Mus.

Ochthoeca polionota pacifica BERLEPSCH, 1907 (Feb.), Ornith., XIV, p. 354—La Paz, w. Bolivia; Frankfurt Mus.

Muscisaxicola morenoi BRUCH, 1904, Rev. Mus. La Plata, XI, p. 258—Santa Catalina, Jujuy.

A female from Puno and a bird without given sex from Tirapata appear to be closer to *oenanthoides* than to *polionota*. The localities are both in the neighborhood of Lake Titicaca and in better regional association with the range of *oenanthoides* than with that of the central Peruvian form.

Both birds are somewhat darker than two north-Argentine specimens and, although I have not compared them directly with examples from

northern Chile, I have found three Chilean birds to differ from other Argentine specimens in this same manner and have little doubt that the north-Chilean and south-Peruvian birds will be found to be much alike. The Puno and Tirapata specimens are distinctly paler than any skin of *polionota* examined. The Tirapata bird has a pale wing-bar which is only suggested in the Puno example.

Thus the members of the group from southeastern Perú are not at all uniform in their characters, and while those from the northern drainage are closer to *polionota*, they show various degrees of approach to *oenanthoides* while the reverse is true of specimens from the southern drainage.

There is another record from Puno which has been placed under *polionota*, but on the basis of the evidence now at hand it should be transferred to *oenanthoides*.

SPECIMENS EXAMINED

O. o. oenanthoides.—BOLIVIA: Cuchacancha, 1 ♀. ARGENTINA: Tilcara, 2 ♂; Colalao del Valle, 3 ♂¹. PERÚ: Puno, 1 ♀; Tirapata, 1 (?). CHILE: Putre, 1 ♂¹, 2 ♀¹.

O. o. polionota.—PERÚ: Pitumarca, 1 ♂ (paratype); Cuzco, 1 ♂; La Raya, 1 ♂, 1 ♀; Chipa, 3 ♂, 4 ♀; Junín, 1 (?); La Quinua, 2 ♀¹; Oconeque, 1 ♂; Limbani, 1 ♀; Huamachuco, 1 ♂.

Ochthoeca fumicolor brunneifrons Berlepsch and Stolzmann

Ochthoeca oenanthoides brunneifrons BERLEPSCH AND STOLZMANN, 1896, P. Z. S. London, p. 355—Maraynioc, Perú; Frankfort Mus

Peruvian birds from the central and northern parts of the country do not differ greatly among themselves. Most of the Ecuadorian skins at hand are likewise indistinguishable.

Some skins from Ecuador, particularly the northern part, and from southern Colombia are distinctly more rufescent on the under parts and much darker brown on the upper parts, but they are not perfectly constant and specimens from Santa Isabel, Colombia, are quite like central Peruvian examples. The localities from which such dark birds are at hand are Valle de las Pappas (March) and coast range west of Popayan (July), Colombia, and "Pichincha" (January), "Papallacta" (February), Taraguacocha (August), and upper Sumaco (January), Ecuador. One Peruvian bird from La Lejia exhibits traces of this same depth of hue but since it is in molt and retains some of the faded feathers of its older dress, exact comparison is difficult.

Beyond Santa Isabel, at Santa Elena, and at Paramillo in the north-

¹ Specimens in Field Museum of Natural History, Chicago

ern part of the western Colombian Andes, the birds appear to be even more rufescent on the under parts and are likewise quite rufescent above without the dark brown coloration of the Valle de las Pappas specimens. This character was noted by Chapman (1917, Bull. Amer. Mus. Nat. Hist., XXXIII, p. 428) who ascribed it to a seasonal cause since the rufous birds were taken in November and January, the dark and somewhat rufous skins in March and July, and the typically lighter plumaged examples in September. However, I have Peruvian specimens taken in March, April, June, July, August, October, November, and December and Ecuadorian specimens dated in January, February, May, and September, and I am unable to find a seasonal distinction which would account for the intensity of coloration exhibited by the Paramillo and Santa Elena birds. The darker tones of the north-Ecuadorian and south-Colombian specimens are not quite accounted for on this basis, either, but it is doubtful if they are due to more than individual variation with a possibility of some bearing on the lines of divergence of the rufous north-Colombian populations. The latter, in addition, are smaller than true *brunneifrons* and appear to deserve a name as follows below.

Peruvian records of *brunneifrons* are from Paucal and Montaña Hucan, above Cutervo.

Ochthoeca fumicolor ferruginea, new subspecies

TYPE from Santa Elena, Antioquia, Colombia; altitude 9000 feet. No. 133,640, American Museum of Natural History. Adult male collected November 15, 1914, by Miller and Boyle; original No. 10,046.

DIAGNOSIS.—Similar to *O. f. brunneifrons* of central and northern Perú, Ecuador, and southern Colombia, but smaller and more rufescent.

RANGE.—Temperate Zone of the northern ends of the Western and Central Andes of Colombia.

DESCRIPTION OF TYPE.—Forehead buffy whitish, continued over the eyes in a broad superciliary stripe which changes to cinnamon over the auriculars; top of head near Sepia, somewhat grayer anteriorly; back Auburn × light Chestnut; upper tail-coverts somewhat browner. Lores dull grayish; auriculars dull brownish; chin whitish, forming a distinct patch; malar region and sides of neck Cinnamon-Brown × Dresden Brown; lower breast and belly deep Cinnamon-Rufous × Ferruginous; breast, throat, and sides a little duller; flanks Ferruginous × Burnt Sienna; lower mid-belly restrictedly whitish; under tail-coverts pale ochraceous buff. Wings sooty; outer margins of inner secondaries and tertials narrowly pale rufescent, broadest on inner tertials; greater upper wing-coverts broadly tipped with bright Mikado Brown; median series with tips deeper rufous; lesser series colored like the mantle; under wing-coverts and axillars much like the upper belly; inner margins of remiges narrowly whitish. Tail sooty, with outer margin of outer web of outermost rectrices indistinctly pale. Bill (in dried skin) blackish; feet blackish. Wing, 80 mm.; tail, 69.25; exposed culmen, 11; culmen from base, 15.5; tarsus, 20.5.

REMARKS.—Female like the male in color but smaller; wing, 76.5–78 mm.; tail, 65–68.5. The males, in series, measure: wing, 78–84 mm.; tail, 69.25–74.

The depth of color on the under parts in this form shows a decided trend in the direction of *superciliosa* of the Mérida region of Venezuela. The Mérida birds differ from all the forms heretofore assigned to the *fumicolor* group by the uniform cinnamomeous superciliaries, the obscurity of the upper parts, the completely white outer web of the outer remiges, and the single wing-bar, but these characters are no more than extremes of characteristics found in *fumicolor* and its conspecifics. The outer web of the outer tail-feathers is narrowly margined with paler, in these forms, although it is never clear white. The superciliaries vary from plain whitish to a decided cinnamomeous hue on the posterior portion. The upper parts are variable in hue. The wing-bar on the median wing-coverts is sometimes very dark and inconspicuous and far from the prominent band which it is in other cases. So far as range is concerned, *superciliosa* merely extends the range of the *fumicolor* group without encroaching on it at any place.

These considerations and the undoubted affinity which *superciliosa* has to the *fumicolor* group impel me to include the Mérida form with *fumicolor* as the most northern, as well as the most richly colored member of that species.

Ochthoeca fumicolor berlepschi Hellmayr

Ochthoeca fumicolor berlepschi HELLMAYR, 1914, Novit. Zool., XXI, p. 167—Malaga, w. Bolivia; ♂; Berlepsch Coll., Frankfurt Mus.

Specimens from southeastern Perú and from the Urubamba Valley belong to the Bolivian form as has been determined by previous workers.

Aside from the localities from which material has been examined as noted herewith, there is a record from Cachupata.

SPECIMENS EXAMINED

O. f. fumicolor.—COLOMBIA: "Bogotá," 9 (?); Choachi, 2 (?); El Piñón, 2 ♂, 1 ♀; Chipaque, 3 ♂, 1 ♀, 1 (?); La Mar, Cundinamarca, 2 ♂; Palo Hueco, 1 ♀¹. VENEZUELA: Páramo de Tamá, 3 ♀¹.

O. f. ferruginea.—COLOMBIA: Santa Elena, 2 ♂ (incl. type), 1 ♀, 1 (?); Paramillo, 3 ♂, 5 ♀.

O. f. brunneifrons.—COLOMBIA: Santa Isabel, 6 ♂, 5 ♀; coast range west of Popayan, 1 ♂; Valle de las Pappas, 3 ♂, 1 ♀, 1 (?). ECUADOR: Oyacachi, 4 ♂; Mojanda, 1 ♂, 2 ♀; Cayambe Mountains, 1 ♀; upper Sumaco, 1 ♂; Papallacta,

¹ Specimens in Field Museum of Natural History, Chicago.

2 ♂, 1 ♀; Pichincha, 1 ♂, 3 ♀; Lloa, 1 ♂; Bestion, 1 ♂, 2 ♀; Mt. Chimborazo, 2 ♂; Urbina, 2 (?); Cerro Huamani, 1 ♂; Quito, 2 (?); Taraguacocha, 2 ♂; El Paso, 1 ♂; Yanacocha, 1 ♀. PERÚ: Maraynioc, 2 ♂, 2 ♀; Pariayacu, 2 ♂; Levanto, 1 ♂; Leimebamba, 1 ♂; Taulis, 2 ♂, 1 ♀; Chugur, 2 ♂; La Lejía, 1 ♂, 2 ♀; Molinopampa, 1 ♀¹; mountains east of Balsas, 1 ♀¹; mountains near Huánuco, 2 ♂¹, 1 ♀¹.

O. f. berlepschi.—PERÚ: Machu Picchu, Cedrobamba, 1 ♂, 1 ♀; Limbani, 1 ♂. BOLIVIA: Cocapuncu, 1 (?); (no locality), 1 (?).

O. f. superciliosa.—VENEZUELA: Mérida region (Escorial, La Culata, El Valle, Conejos, Lagunillas, El Loro, Mérida), 10 ♂, 5 ♀, 7 (?).

Ochthoeca leucophrys leucometopa Sclater and Salvin

Ochthoeca leucometopa SCLATER AND SALVIN, 1877, P. Z. S. London, p. 19—part; type from Chihuata (above Arequipa), Perú; British Mus.

Six males and two females from Cocachacra, two females from Lomas (near Cachendo), and a female from Jesus (above Arequipa) all agree in the relative grayness of the upper parts, the broad and well-defined white forehead, and the large bill. The uropygium is somewhat brighter and warmer than the mantle but much less so than in any of the birds from the true Andean plateau. The range of *leucometopa* thus appears to be restricted to the Pacific slope of the Andes from the neighborhood of the Rimac Valley, above Lima, south to extreme northern Chile. The highlands of Junín are inhabited by a distinct form which is much darker than the coastal birds and which has been separated under the name *interior*, next to be discussed.

Records of *leucometopa* are from Chihuata, Islay, and Palca.

Ochthoeca leucophrys interior Zimmer

Ochthoeca leucophrys interior ZIMMER, 1930 (Dec. 10), Field Mus. Nat. Hist. Publ., Zool. Ser., XVII, p. 365—mountains near Huánuco, Perú; ♂; Field Mus. Nat. Hist.

A male from Acobamba, a female from Oroya, and two males, three females, and a young bird of uncertain sex from Chipa maintain the characters given for this central Peruvian form. The general coloration is dark, especially on the top of the head where its dusky hue is in greater contrast to the color of the back than in the allied forms. The bill is about as broad as in *leucometopa* although averaging a little shorter.

The range of *interior* may thus be expanded to the southward to cover the Junín region from Huánuco on the north to the valley of the upper Mantaro on the southeast. Records are from Tarma, Acobamba, Acancocha, and Huanta.

Ochthoeca leucophrys urubambae, new subspecies

TYPE from Ttica-Ttica, near Cuzco, Perú; altitude 11,500 feet. No. 145,230, American Museum of Natural History. Adult male collected July 2, 1916, by Frank M. Chapman and George K. Cherrie.

DIAGNOSIS.—Similar to *O. l. leucometopa* of the coast region of southern Perú and northern Chile, but with the coloration of the back much less grayish and more buffy brownish; forehead averaging more narrowly and less sharply white; bill shorter and more slender. Compared with *O. l. interior* of the Junfn highlands, the dorsal coloration is paler and the bill is more slender though not always shorter.

RANGE.—Urubamba Valley, Perú; Temperate Zone.

DESCRIPTION OF TYPE.—Top of head Mouse Gray; forehead rather narrowly whitish, tinged with gray medially but purer white over the lores and continuous with a broad white superciliary stripe; mantle light Hair Brown anteriorly, tinged with Drab posteriorly and passing into Buffy Brown on the rump; upper tail-coverts like the upper mantle. Lores sooty gray continuous with a narrow blackish line over the eye, widening into a broad dark fuscous patch occupying the auriculars; chin and throat grayish white centrally, more grayish laterally; the malar region, a subocular lunule, and the base of the auriculars also whitish; breast light grayish, darker gray on the sides; belly, flanks, and under tail-coverts white with a faint grayish tinge, especially laterally. Wings fuscous; outer margins of inner secondaries buffy; tips of inner secondaries and outer margins and tips of tertials more whitish; bend of wing, outer margin of outer primary-covert, and a narrow outer margin of outer primary white; greater upper wing-coverts with rather inconspicuous margins of light cinnamonaceous buff; similar margins suggested on the median series; under wing-coverts and inner margins of the remiges white. Tail fuscous black with fine whitish tips on most of the rectrices; outer rectrices with entire outer webs white except near the tips where the blackish color of the inner web encroaches in a small dark spot, not reaching the outer margin. Bill (in dried skin) black; feet black. Wing, 80 mm.; tail, 73; exposed culmen, 11.5; culmen from base, 15.5; tarsus, 21.5.

REMARKS.—Female similar to the male.

The length of bill (culmen from base) appears to vary between 15 and 16.5 mm. while in *leucometopa* it measures from 16.5 to 19. The difference in the width of the bill is less easily shown by tabulated measurements, but the appearance in the two forms is quite markedly different in most specimens and in series is particularly noticeable.

As in the allied forms, occasional skins show ill-defined wing-bars of a rufescent tone and young birds may have such bands well developed and bright cinnamon-rufous, with considerable resemblance to typical *leucophrys*.

Records are from Chospiyoc, Calca, Pisac, Cuzco, Tinta, Anta, Urubamba, Lauramarca, and Paucartambo.

In northern Perú, on the eastern side of the Western Andes (including the valleys of the Río de Huaras and the Río Chuquicara), the birds are again different from *interior* and *leucometopa* and are closer to *urubambae*,

although more warmly colored on the upper parts. In 1930 (Field Mus. Nat. Hist. Publ., Zool. Ser., XVII, p. 365) I identified birds of this sort as *leucometopa* with some hesitation, but a more adequate series now at hand reveals their distinction. This form may be known as follows.

Ochthoeca leucophrys cajamarcae, new subspecies

TYPE from Cajamarca, Perú; altitude 9500 feet. No. 495,212, American Museum of Natural History. Adult male collected June 22, 1894, by O. T. Baron.

DIAGNOSIS.—Similar to *O. l. interior* of the Eastern Andes in the Junín region of central Perú, but coloration of the upper parts somewhat lighter, the top of the head, especially, not so dark, and with a generally warmer tone on the back; bill slightly smaller. Compared with *O. l. urubambae* of the Urubamba region, the upper parts are more deeply colored. Compared with *leucometopa* of the southern coastal region, the hue of the upper parts is decidedly warmer and darker, and the bill is smaller as in *urubambae*.

RANGE.—Humid Temperate Zone of northern Perú in the Western Andes, from above Aguamiro to the Cajamarca region.

DESCRIPTION OF TYPE.—Forehead and broad superciliary stripe white; top of head dark Hair Brown; mantle slightly darker than Hair Brown anteriorly, a little darker and warmer posteriorly, and passing into a definite rufescent hue (near light Bister \times Sepia) on the rump; upper tail-coverts like the anterior mantle. Lores dark Fuscous, slightly tinged with grayish; a narrow fuscous line over the eye; auriculars dark fuscous with some white at base of lower feathers; a small whitish lunule below the eye; malar region whitish; chin and throat pale grayish, darker laterally; breast pale gray, darker on the sides; flanks lighter gray; middle of belly and under tail-coverts white. Wings Fuscous; outer margins of the secondaries and tertials whitish, with a slight buffy tinge basally; bend of wing, outer web of outer primary covert, and a narrow outer margin of outer primary white; median and greater upper wing-coverts with inconspicuous margins of dull rufescent brown; under wing-coverts grayish white; inner margins of remiges buffy whitish; tail Fuscous with outer web of outer rectrices white except at tip where the white is restricted to a narrow outer margin; all rectrices with suggestions of narrow white tips. Bill (in dried skin) blackish; feet dark brown. Wing, 79 mm.; tail, 70; exposed culmen, 11; culmen from base, 16; tarsus, 22.

REMARKS.—Female like the male.

A topotypical male is somewhat darker than the average, showing an approach toward the characters of *interior*.

Ochthoeca leucophrys piurae Chapman

Ochthoeca piurae CHAPMAN, 1924 (June 20), Amer. Mus. Novitates, No. 118, p. 3—Palambra, Perú; ♂; Amer. Mus. Nat. Hist.

The two original specimens, male (type) and female are the only recorded examples of this interesting form. It is the most distinct of the various members of the group, although its affinity is closer to *leucometopa* than to any other species. It is decidedly smaller than its conspecific and has the bill exceptionally short, though broad. The back is

even more rufescent than in typical *leucophrys* and darker, although the bands across the wing are much the same in the two birds. The outer web of the outer rectrix is entirely white as in many skins of *leucophrys* and, in addition, the entire outer web of the outer primary is similarly white, whereas only the outer margin of the outer web of this feather is white in the allied forms. The white lunule below the eye is not so positive in *piuræ* as in its conspecifics, but it is present and adds one more link in the chain of characters pointing to the relationship herein accepted.

SPECIMENS EXAMINED

O. l. piuræ.—PERÚ: Palambla, 1 ♂ (type), 1 ♀.

O. l. cajamarcae.—PERÚ: Cajamarca, 3 ♂ (incl. type), 1 ♂¹; Cajabamba, 3 ♂, 1 ♀; Santiago, 1 ♂, 1 ♀; Huamachuco, 1 ♀; Tulpo, 1 (?); Macate, 1 ♂¹; Cullcui, 1 ♂¹.

O. l. interior.—PERÚ: Mountains near Huánuco, 1 ♂ (type)¹, 1 ♀¹; La Quinua, 2 ♂¹, 2 ♀¹; Acobamba, 1 ♂; Chipa, 2 ♂, 3 ♀, 1 (?); Oroya, 1 ♀.

O. l. urubambæ.—PERÚ: Ttica-Ttica, 3 ♂ (incl. type); Ollantaytambo, 2 ♂, 1 ♀; Huaracundo Cañon, 4 ♂, 3 ♀, 1 (?); Cuzco, 3 ♂, 4 ♀; Lucre, 2 ♂.

O. l. leucometopa.—PERÚ: Jesus, Arequipa, 1 ♀; Cocachacra, 6 ♂, 2 ♀; Lomas, near Cachendo, 2 ♀; Matucana, 3 ♂¹. CHILE: Putre, 1 ♂¹, 2 ♀¹.

O. l. leucophrys.—BOLIVIA: Vinto, Cochabamba, 2 ♂, 1 ♀; Tujma, 4 ♀; Parotani, 2 ♂; California, Santa Cruz, 1 ♀.

O. l. tucumana.—ARGENTINA: Norco, Tucumán, 3 ♂, 1 (?); Sarmiento, 1 ♀; La Cienaga 1 ♂, 1 ♀; Anfama, 1 (?); Aconquija, 1 (?); Las Pavas 5 (?); Tafi Viejo, 1 ♀.

Ochthoeca rufi-pectoralis rufi-pectoralis D'Orbigny and Lafresnaye

F(luvicola) rufi-pectoralis D'ORBIGNY AND LAFRESNAYE, 1837, Mag. Zool., VII, cl. 2, Syn. Av., p. 60—Ayupaya, rep. Boliviana; Paris Mus.

Limhani, 5 ♂, 1 ♀, 2 (?); Oconeque, 1 ♂.

Typical *rufi-pectoralis* is separable from the other members of the species by the absence of the broad rufous band across the wing on the tips of the greater wing-coverts. This band, nevertheless, is indicated in numerous specimens by touches of rufous at the tips of the greater coverts which may be complete enough to form a very narrow line across the wing. Such indication is more prevalent in birds from southeastern Perú (approaching the range of *tectricialis*), although it is present also in Bolivian examples from as far east as the Cochabamba region. Taczanowski describes a specimen with a narrow rufous wing-bar, from Cachupata, Perú, placing it in *rufi-pectoralis* as does Sclater in the 'Catalogue of Birds of the British Museum.' Hellmayr places these references

¹ Specimens in Field Museum of Natural History, Chicago.

under *tectricialis* which has narrower wing-bars than the other forms to the northward, though these bars are wider than in any of the extreme examples of *rufi-pectoralis* at hand.

Cachupata, though in the Department of Cuzco, is east of the Eastern Andes, in the same general region as the Carabaya and Marcapata districts which are in the range of *rufi-pectoralis*, and from Taczanowski's description of his Cachupata bird I conclude that it was a specimen very like some of the skins of *rufi-pectoralis* now before me; hence I replace the record under the Bolivian form.

Other records of *rufi-pectoralis* are from Marcapata and Limbani.

Ochthoeca rufi-pectoralis tectricialis Chapman

Ochthoeca lessoni tectricialis CHAPMAN, 1921, Bull. U. S. Nat. Mus., CXVII, p. 88—Huaracundo Cañon, Perú; ♂; Amer. Mus. Nat. Hist.

Huaracundo Cañon, 1 ♂ (type), 1 ♀; Cedrobamba, 1 ♂; Maraynioc, 5 ♂, 4 ♀, 1 (?); Rumicruz, 2 ♂, 4 ♀.

Extreme examples of this form have the rufous bar on the wing moderately narrow, though quite clear and distinct, but some examples at the other extreme have it as wide as in the narrowest extreme of *rufopectus*. The average is thus somewhat less than in *centralis*. The back averages a little browner than in *centralis* but decidedly browner than in *rufopectus* or *rufi-pectoralis*, and the rufous color of the breast is relatively dark and extensive as in the typical form.

The birds with the narrowest wing-bars appear to be those from the Urubamba Valley, in closest proximity to the range of *rufi-pectoralis*, while the skins from those nearest the range of *centralis* approach that form more closely. Intergradation is thus regular in respect to this character.

Records are from above Torontoy, Machu Picchu, and Pumamarca.

Ochthoeca rufi-pectoralis centralis Hellmayr

Ochthoeca rufi-pectoralis centralis HELLMAYR, 1927 (April 11), Field Mus. Nat. Hist. Publ., Zool. Ser., XIII (5), p. 49—Panao Mts., Perú; ♀; Field Mus. Nat. Hist.

San Pedro, south of Chachapoyas, 2 ♀; La Lejía, 4 ♂, 1 ♀, 1 (?); Levanto, 1 ♂, 1 ♀; Leimebamba, 2 ♀.

In this form, the wing-bar averages wider than in *tectricialis* (although it is equalled by some specimens of that form); the back is as in *tectricialis*, being browner than in *rufi-pectoralis* and *rufopectus*; and the pectoral area is much like that of *rufopectus* in extent (narrower than in

tetricialis and *rufi-pectoralis*) though somewhat clearer rufous than in *rufopectus*, less intense than in *tetricialis* or *rufi-pectoralis*.

I have not seen examples from west of the Marañón east of the Western Andes, which Hellmayr referred to *centralis* (without, however, examining the specimens). There is a possibility that they may be referable to *rufopectus* which is found on the western slope of these mountains in Perú but on both eastern and western drainages in Ecuador. Specimens from Molinopampa, near Chachapoyas, are somewhat intermediate between the two forms, but the specimens listed above are all clearly *centralis*. The record from Paucal rather certainly belongs to *rufopectus* (q.v.).

Records are from Panao Mountains, mountains near Huánuco, and Molinopampa with certainty; Tambillo, Cutervo, Palto, and Tamia-pampa, with some question.

Ochthoeca rufi-pectoralis rufopectus Lesson

Tyrannulus rufopectus LESSON, 1844 (Aug.), *Écho du Monde Savant*, XI, No. 10, p. 233—"Colombie" = Bogotá.

El Tambo, 1 ♂, 2 ♀; Chugur, 2 ♂; Taulis, 2 ♂, 3 ♀, 1 (?).

Birds from the western slope of the Western Andes in Perú are inseparable from all the Ecuadorian specimens and most of the Colombian ones, excluding *poliogastra* of the Santa Marta region. Whether or not these Colombian birds all belong to *rufopectus* is not determinable at present. Chapman (1917, *Bull. Amer. Mus. Nat. Hist.*, XXXVI, p. 429) pointed out that a bird from Palo Hueco, near Bogotá, was more olivaceous above than more western (and southern) specimens, while old "Bogotá" skins were much ruddier.

I have seen seven "Bogotá" skins, including the three mentioned by Chapman, and all agree in their relative paleness and ruddiness. Young birds sometimes exhibit a similar tone of coloration, but the Bogotá birds are not young.

On the other hand, a specimen from the Western Andes, above Salento, is very much like the Palo Hueco bird, although a number of skins from Laguneta (between Bogotá and Salento) and one from the Paramillo trail, farther to the northward, are quite like the average Colombian and Ecuadorian examples.

It is quite possible that the ruddy color of the Bogotá birds is due to postmortem change, but it seems likely that the original color of these specimens was paler on the back than the dark hue exhibited by most of the Colombian examples. The problem must await solution by the

collection of a series of fresh specimens in the vicinity of Bogotá to determine the exact character of typical *rufospectus*. Should it be found to be a regularly pale-backed form, a new name must be supplied for the extensive population ranging from the Central and Western Andes of Colombia through Ecuador to northwestern Perú.

I have noted on an earlier page that records from the eastern side of the Western Andes, west of the Marañón, (Tambillo, Cutervo, Palto, and Molinopampa) may possibly belong to this form instead of to *centralis*. There is a direct Temperate Zone connection between Cutervo and Chugur and also a broken Subtropical Zone connection, whereas between Cutervo and the Chachapoyas region the Subtropical Zone is broken by the cañon of the Marañón; the Temperate Zone is similarly interrupted in the north though it is continuous by way of the extreme head of the Río Marañón, a long way to the south. Nevertheless, both patterns of distribution occur in different species and it is impossible to speak with certainty in the present case without an examination of pertinent material. Chugur specimens are *rufospectus* and the Chachapoyas birds are *centralis*. The records from the dubious localities may be left with *centralis*, where Hellmayr has assigned them, until proof of the contrary is forthcoming.

The record from Paucal I would unhesitatingly transfer to *rufospectus* which occurs at Taulis only a few miles away in the same region.

Myiotheretes striaticollis striaticollis (Sclater)

Taenioptera striaticollis SCLATER, 1853 (June), P. Z. S. London, XIX (for 1851), p. 193, Pl. XLII—Ecuador; coll. of Edward Wilson, repository unknown.

Orodymastes striaticollis columbianus TODD, 1913 (August 8), Proc. Biol. Soc. Wash., XXVI, p. 171—San Lorenzo, Santa Marta Mts., Colombia; ♂; Carnegie Mus.

Cajabamba, 2 ♂, 1 ♀; Cajamarca, 1 ♀; Taulis, 3 ♂; La Lejia, 2 ♂; San Pedro, 1 ♀; Uchco, 1 ♀; Utcuyacu, 2 ♂.

Peruvian birds from as far south as the Junín region are not clearly separable from Ecuadorian and Venezuelan specimens although there is a tendency toward heavier and blacker streaks on the anterior under parts in the Peruvian examples.

Skins from the extreme southeastern part of the country, on the other hand, are readily distinguishable and belong to the north-Argentine subspecies, *pallidus*, next to be discussed.

This raises the question of the identity of *Tyrannus rufiventris* of D'Orbigny and Lafresnaye, heretofore placed in the synonymy of typical *striaticollis* but possibly properly belonging under *pallidus*. Fortunately,

the name is preoccupied and its identity is only a matter of academic interest which can have no effect on the nomenclature of the group. The identity of other Bolivian specimens is discussed under *pallidus*.

Records of *striaticollis* are from Huancabamba, Garita del Sol, Pariayacu, Auquimarca, Chachapoyas, Succha, Paucal, Chinchao, and Panao.

***Myiotheretes striaticollis pallidus* Berlepsch**

Myiotheretes striaticollis pallidus BERLEPSCH, 1906 (May), Bull. Brit. Orn. Cl., XVI, p. 98—Norco, Tucumán, Argentina; ♂; Frankfort Mus.

Inca Mine, 1 ♂, 1 ♀; Santo Domingo, 2 ♂, 1 ♀; Marcapata, 1 (?).

Compared with six birds from the Tucumán region, these southeast-Peruvian examples agree quite closely, confirming Chapman's observation (1926, Bull. Amer. Mus. Nat. Hist., LV, p. 472) on the Inca Mine specimens and one Tucumán bird.

The case is not so simple with regard to Bolivian specimens. D'Orbigny and Lafresnaye (1837, Mag. Zool., VII, cl. 2, Syn. Av., p. 45) described the Bolivian birds under the name *Tyrannus rufiventris* (antedated by Vieillot, 1823). The reference has been placed under typical *striaticollis* by all authors, and Hellmayr found the type to be "not appreciably different from Peruvian and Ecuadorian examples." I have two examples from Bolivia; one from near La Paz and the other from the Cochabamba region. The La Paz (Pongo) skin is in worn condition but agrees well with a comparable specimen from Santo Domingo, Perú. The Cochabamba (Incachaca) skin is very fresh and is very similar to a bird of the same sex and season (female; May) from Concepcion, Tucumán, except that it is slightly darker on the upper surface and has a slightly larger bill. It is not, however, so dark nor so large-billed as typical *striaticollis*, nor is the breast so heavily streaked nor the belly so clear rufescent as in the northern form, both being much more like *pallidus*. There is about the same amount of difference between this bird and the series of *pallidus* as is exhibited by the extremes of *striaticollis*, and it seems probable that it represents only an extreme of individual variation in the southern form. Until more evidence is forthcoming, therefore, I believe that D'Orbigny and Lafresnaye's *rufiventris* should be included in the synonymy of *pallidus*.

Records from Perú which should belong to *pallidus* are from Huaynapata and Cachupata.

***Ochthoeca diadema cajamarcae* Carriker**

Ochthoeca diadema cajamarcae CARRIKER, 1934 (June 25), Proc. Acad. Nat. Sci. Phila., LXXXVI, p. 326—Chira, near Tambillo, Perú; ♂; Acad. Nat. Sci. Phila.

I have not seen this form. The only given character which appears to be outside the normal range of variation of *gratiosa* is the absence of the olivaceous band across the chest, and this feature is shown by examples of *gratiosa* from the central Andes of Colombia. The form may be provisionally recognized until more material is forthcoming to substantiate its validity. The material used for comparison by its author was wholly inadequate to show the variations of the previously known forms. The wide gap between the region of Tambillo and the northernmost part of Ecuador gives a geographic isolation for *cajamarcae* which is, perhaps, the strongest point in its claim to recognition.

An earlier record which presumably belongs here is from Tambillo.

Ochthoeca cinnamomeiventris angustifasciata Chapman

Ochthoeca thoracica angustifasciata CHAPMAN, 1926 (Oct. 16), Amer. Mus. Novitates, No. 231, p. 2—La Lejia, north of Chachapoyas, Perú; ♂; Amer. Mus. Nat. Hist.

La Lejia, 3 ♂ (incl. type), 3 ♀; Leimemamba, 1 ♂, 1 ♀; Chachapoyas, 1 ♂.

A well-marked form, readily distinguishable from the birds of the southeastern part of Perú and Bolivia although approached by certain examples from the Junín region (cf. account of *O. c. thoracica*).

Taczanowski (1884, 'Orn. Pérou,' II, p. 197) recorded a specimen of "*nigrita*" from Tambillo, from which locality he also recorded "*thoracica*" (= *angustifasciata*). The measurements of his specimen of "*nigrita*," a female, show the tail to be 55 mm., a dimension much too large for true *nigrita* though well within the measurements of *angustifasciata*. This discrepancy, together with the fact that *thoracica*, and presumably *angustifasciata*, may lack the chestnut pectoral band in certain immature examples (cf. account of *thoracica*), points to the great probability that this Tambillo bird was misidentified, a conclusion already reached by Hellmayr.

Ménégaux (1910, Rev. Franc. d'Orn., I, p. 322) records "*thoracica*" from Cumpang (= Compan). It is probable that the record belongs to *angustifasciata*, which was undescribed in 1910. Other records assignable to the north-Peruvian form are from Tamiapampa, Molinopampa, and Tambillo.

Ochthoeca cinnamomeiventris thoracica Taczanowski

Ochthoeca thoracica TACZANOWSKI, 1874, P. Z. S. London, p. 133—Chilpes, Perú; ♂; type formerly in Warsaw Mus., now lost.

Chilpes, 1 ♂, 3 ♀; Maraynioc, 1 ♂; Rumicruz, 3 ♂, 3 ♀, 2 (?);

Torontoy, 1 ♀; Santo Domingo, 2 ♀; Limbani, 1 ♀; Inca Mine, 1 ♂, 1 ♀.

It is somewhat unfortunate that the present form was described from a region where the representatives of the species are least positive in their characters. Although the specimens from central Perú have the rufous pectoral band averaging wider than in *angustifasciata* of northern Perú, they are exceeded in this respect by the average of specimens from southeastern Perú and Bolivia. Likewise, the white superciliary stripe is more extended in the northern birds and less in the southernmost while it is intermediate in the Junín examples. The top of the head is inclined to be rather darker in the southern birds and paler in the northern ones, and again this is intermediate in the specimens from the central part of the country.

There is thus a regular progression of characters from Bolivia and southeastern Perú to northern Perú, as has been pointed out by Chapman (1926, Amer. Mus. Novitates, No. 231, p. 3), with the two extremes at opposite ends of this range. On the whole, the typical examples are somewhat closer to the southern extreme, as Chapman also concluded. In any case, it is better to leave *thoracica* with some positive characters than to relegate it to an intermediate position and accordingly I refer the southern birds to it in preference to naming this extreme as new.

I have no doubt of the representative character of *thoracica* (and *angustifasciata*), *cinnamomeiventris*, and *nigrita*. Colombian and Ecuadorian birds (*cinnamomeiventris*) have the pectoral band widened to include the flanks and abdomen, though not the throat and under tail-coverts, and the Venezuelan examples (*nigrita*) have lost the band entirely. In *cinnamomeiventris*, furthermore, the white of the under wing-coverts and axillars is more pronounced than in the other forms. Otherwise, these birds are all very much alike. The Colombian and Ecuadorian form is intermediate in size between the Peruvian and the Venezuelan forms, with the Venezuelan *nigrita* the smallest of the series.

These differences mentioned are greater than those which distinguish *thoracica* from *angustifasciata*, but they are of exactly the same nature, being carried to a greater extreme. As a combined group, the series of forms is easily segregated from the other members of the genus by the characters which they share in common, and I believe the best expression of their obvious relationship is accomplished by uniting them into a common species of which *cinnamomeiventris* is the oldest name.

It may be of interest to add that in a small series of *nigrita*, several specimens show traces of rufescence on the tips of the axillars, on the

abdomen, or even on the margins of certain breast-feathers. Although this is far from the formation of a definite pectoral band, it is an indication of some value in the determination of relationships. Similarly, specimens of *thoracica* in immature plumage sometimes have the entire abdomen tinged with brown of a greater or lesser degree of rufescence. On the other hand, immature examples of *thoracica* sometimes lack the chestnut band across the breast, according to accounts, although it is definitely present in all the birds I have at hand. A specimen without this chestnut is presumed to have been the basis for Taczanowski's record of "*nigrita*" from Tambillo (cf. account of *angustifasciata*).

Records of *thoracica* are from Higos and Uruhuasi.

Ochthoeca albidiadema spodionota Berlepsch and Stolzmann

Ochthoeca jelskii spodionota BERLEPSCH AND STOLZMANN, 1896, P. Z. S. London, p. 356—Pariayacu, Maraymuc, Perú; ♂; Warsaw Mus.

Ochthoeca jelskii boliviana CARRIKER, 1935 (Oct. 10), Proc. Acad. Nat. Sci. Phila., LXXXVII, p. 331—Hichuloma, Dept. La Paz, Bolivia; ♂; Acad. Nat. Sci. Phila.

Rumicruz, 1 ♂.

Compared with a male from Cedrobamba, above Machu Picchu, in the U. S. National Museum collection. Both birds agree in the decidedly olivaceous brown hue of the lower back, grayish upper mantle, and relatively inconspicuous bar across the median wing-coverts; the bar on the greater coverts and the cinnamonaceous outer edges of the tertials and inner secondaries are broad and well-marked in the Cedrobamba bird but less well developed in the Rumicruz specimen where the edges of the inner secondaries are grayish and those of the tertials very narrowly rufous. The two birds in hand agree very well with the original description of this form.

In describing "*boliviana*," Carriker evidently had only immature specimens of *spodionota* for comparison. His description of *spodionota* as having the mantle chestnut brown and the upper tail-coverts ochraceous agrees neither with the original description of this form nor with the two birds now before me, but differs in about the same degree as young *jelskii* differs from the adults of that form; unfortunately, I have no young *spodionota* for examination in this connection. In any case, the description of "*boliviana*" shows no characters distinguishing it from the adult Peruvian birds. Three specimens from Incachaca, Boliva, in the Carnegie Museum, Pittsburgh, also appear to be typical *spodionota*, extending the range of this form eastward to the Cochabamba region.

This subspecies bridges the gap between *jelskii*, with its heavily

banded wings, and *albiadema*, *frontalis*, and *orientalis*, with only vestiges of wing-bars. In the warmth of dorsal coloration, however, the three northernmost forms show the intermediate characteristics, while in the degree of cinnamonaceous coloration of the lower flanks and crissum, *jelskii* is intermediate.

Peruvian records are from Culumachay and Patás.

Ochthoeca albiadema jelskii Taczanowski

Ochthoeca jelskii TACZANOWSKI, 1883, P. Z. S. London, p. 71—Montaña de Nancho, Perú; ♂; Ramondi Coll., Lima, Perú.

Palambla, 1 ♂; El Tambo, 1 ♀, 1 (?); Taulis, 1 ♂, 3 ♀; Chugur, 1 ♂, 2 ♀, 1 (?).

Adults of this subspecies are rather bright chestnut brown on the lower back and much brighter rufous on the rump, with the upper tail-coverts sooty brown variably tinged with dark rufous, much like the upper mantle. The pileum is fuscous black, about as in *frontalis*; the belly and under tail-coverts are white, although there is a variable tinge of buff on the extreme lower flanks. The chest, sides, and upper flanks are gray, while the throat is gray with indistinct whitish streaks. The wings are crossed by two broad, rufous bars of about equal width. The superciliary stripes, except above the lores, are pure white. The supraloral area and forehead are somewhat paler yellow than in *spodionota* with the frontal band narrower than in that form.

The juvenal plumage differs from the adult in various particulars. The back is more intensely rufous, and the top of the head is brown, tinged with chestnut posteriorly but somewhat grayish on the anterior crown. The rump is very bright and the upper tail-coverts are rufescent. The forehead is rather dull buffy yellow and the superciliary stripes are definitely buff. The under parts have a buffy tone, giving the chest a drab hue but appearing as light buff on the belly and under tail-coverts and cinnamon on the lower flanks. The wings are marked as in the adult although the bars tend to be paler and the ground color somewhat browner. Specimens passing from this plumage to the adult one show various degrees of intermediacy and skins which may be in the first annual dress are much like the adults except that the top of the head is a little lighter fuscous and the superciliaries not so purely white. One such example, a bird without indicated sex, from Taulis, has the superciliaries faintly tinged with yellow rather than with buff, a condition suggesting that the relationships of the present group and *pulchella* will bear still more intensive study.

Ochthoeca albididema orientalis Chapman

Ochthoeca frontalis orientalis CHAPMAN, 1924 (June 20), Amer. Mus. Novitates, No. 118, p. 4—Oyacachi, upper Papallacta River, Ecuador; ♂; Amer. Mus. Nat. Hist.

I have seen no specimens of this form from Perú but Carriker records it from Atuén, above Leimebamba. This leaves a wide expanse of territory on the eastern side of the Andes in southern Ecuador where the form may yet be found to occur but from which there is no existing record.

[*Ochthoeca albididema frontalis* (Lafresnaye) was described from "Pasto, in Peruvia" but is not a Peruvian form; Pasto is in Colombia and the type, now in the Academy of Natural Sciences of Philadelphia, has been determined by Stone and others as representing the form which occurs in western Colombia.]

Ochthoeca pulchella pulchella Sclater and Salvin

Ochthoeca pulchella SCLATER AND SALVIN, 1876, P. Z. S. London, p. 355—Tiltilo, Yungas of La Paz, Bolivia; British Mus.

"Camp 1," below Limbani, 1 ♂, 1 ♀; Rumicruz, 3 (?).

The three birds from Rumicruz are immature but apparently belong to *pulchella* rather than to *O. albididema spodionota* which also occurs at Rumicruz. Their measurements agree well with the adults of *pulchella* but are smaller than those of *spodionota* except for the bill which, in *pulchella*, is heavier than in the *albididema* group. One of the specimens has acquired part of the adult feathering of the superciliary stripe which is shown to be yellow instead of white. Another has some fresh feathering on the middle back which is warmer and browner than in *spodionota*. The wing-bars are decidedly broader than in adult *spodionota* but are like those of adult *pulchella* in development though somewhat paler in hue. The under parts have an olivaceous tone quite unlike the grayish tone of the comparable plumage of *albididema jelskii* to which the young *spodionota* may bear much resemblance, although I have no young *spodionota* with which to establish this as a fact.

Adult *pulchella* has a definitely olivaceous tinge on the mantle and the top and sides of the head which, together with the yellow superciliaries, is suggestive of relationship to the *diadema* group. The *diadema* group has similar proportions, including the stronger bill in comparison to *albididema* and its allies. Carriker (1933, Pr. Acad. Nat. Sci. Phila., LXXXV, p. 23; 1935, *op. cit.*, LXXXVII, p. 331) has pointed out certain conflicts in the ranges of *p. pulchella* and *p. similis* on the one hand, and *spodionota* and *orientalis* on the other hand. The present evidence

of the occurrence of both *jelskii* and *pulchella* at Rumicruz still further indicates the specific separation of the *pulchella* and *albiadiadema* groups. The Carnegie Museum, Pittsburgh, has three specimens each, of both *spodionota* and *pulchella* from Incachaca, Bolivia, showing the similar coincidence of the two species at the most eastern ends of their respective ranges. There is no such conflict between *diadema* and *pulchella*; the ranges appear to be separated by the cañon of the middle Marañón in northern Perú.

More material of both these species from northern Perú is needed to establish clear relationship and for the present they may be left specifically distinct, although their possible affinity should be kept in mind.

O. pulchella pulchella is recorded also from Oconeque near Limbani.

***Ochthoeca pulchella similis* Carriker**

Ochthoeca pulchella similis CARRIKER, 1933 (March 24), Proc. Acad. Nat. Sci. Phila., LXXXVII, p. 23—Leimebamba, Perú; ♂; Acad. Nat. Sci. Phila.

I have not seen this form which is described as having paler wing-bars than *pulchella*, cinnamon-buff under tail-coverts, paler ashy under parts, and buffy brown flanks, as well as darker head and browner, less chestnut brown, rump and upper tail-coverts. These features in large part are shared by immature *pulchella*, except for the ashy under parts and the dark crown. No measurements are given for this subspecies, although it is stated that the wing and tail average about four millimeters longer than in *pulchella*, apparently about as in *jelskii* and *spodionota*.

Known only from the type locality.

***Colonia colonus niveiceps* Zimmer**

Colonia colonus niveiceps ZIMMER, 1930 (Dec. 10), Field Mus. Nat. Hist. Publ., Zool. Ser., XVII (7), p. 368—Poco Tambo (= Pucatambo), Perú; ♂; Field Mus. Nat. Hist.

Additional specimens from various parts of Perú show that *niveiceps* ranges through the humid Upper Tropical Zone throughout the country. Specimens from northern Bolivia seem to be assignable to the same form. As a rule the top of the head is definitely paler than in typical *colonus*, although an occasional specimen of *colonus*, especially if worn and faded, agrees with the darker end of the Peruvian series; none of them reaches so pale an extreme.

There appears to be a definite difference in the length of the tails of male *niveiceps* and the same sex of *colonus*. In the Peruvian form the central rectrices vary between 179.5 and 205 mm.; in *colonus*, between

148 and 170. One skin from Tulumayo, Junín, sexed as a male, has the tail only 162 mm., but the specimen has the color characters of a female and may have been wrongly sexed, although the tail is decidedly longer than in the other females, which range between 121 and 153 mm.

A series of nine specimens from Zamora, eastern Ecuador, is very puzzling. In color, the males are readily distinguished from *niveiceps*, having the top of the head as dark as in the darkest *colonus*. In measurement of the tail they vary between 159 and 194 mm., averaging larger than *colonus* but smaller than *niveiceps*. They appear, also, to be faintly deeper black in general coloration and to have the white space immediately over the eye somewhat more extended posteriad along the upper eyelid. In *colonus* the black of the sides of the head tends to reach forward along the upper eyelid and in a number of specimens attains contact with the black loreal patch, thus cutting off the white of the superciliary region from the orbit. In the Zamora birds, the white sometimes occupies the entire upper eyelid.

These differences are hardly pronounced enough to warrant the application of a separate name for the Zamora birds, although it becomes necessary to refer these provisionally to *colonus*. The range of *colonus* is thus divided by the interposition of *niveiceps*. Possibly a longer series from Zamora may sometime show positive characters which cannot be detected in the material at hand. There is no decided approach toward *fuscicapilla* of northeastern Ecuador although the darker cap and more extended white superciliary may point in that general direction.

In *niveiceps*, the black of the upper eyelid is never so extended as in extreme *colonus* and rarely as limited as in the Zamora birds. Its variability here suggests that it may not prove to be constant in southern Ecuador.

Additional Peruvian records are from Garita del Sol, Paltaypampa, Monterico, and Yahuar Mayo.

None of the Peruvian localities are from the lower portions of the Tropical Zone, nor does *fuscicapilla* appear to descend to any lower level. On the other hand, *leuconota* seems to be found at correspondingly lower elevations, reaching the coast as at Esmeraldas and Barbacoas.

SPECIMENS EXAMINED

C. c. colonus. BRAZIL: Rio de Janeiro, Therezopolis, 1 ♂, 2 ♀, 1 ♂¹, 1 ♀¹; Rio de Janeiro, 1 [♂]; Ponte Marombe, 1 ♂; São Paulo, Victoria, 2 ♂; Piquete 1 ♂; Bahia, Itirussú, 2 ♂, 2 ♀, 1 (?); Taguaquara, 2 ♀, 1 (?); Tequié, 1 ♀; "Bahia," 1 [♀]; Goyaz, Fazenda Esperanza, 3 ♂, 1 ♀; Minas Gerais, Rio Jordão, 2 ♂;

¹ Specimens in Field Museum of Natural History, Chicago.

Fazendinha, 1 ♂; Rio de las Velhas, 1 ♂¹; "Minas Geraes," 1 ♂; Paraná, Fazenda Iguassú, 1 ♂; Guayra, 2 ♂, 1 (?) ; Espirito Santo, Santa Barbara de Caparão, 1 ♂; Santa Catharina, Palmital, 2 ♂, 2 ♀, 1 (?) ; Hansa, 1 ♂, 2 (?) ; Salto Pirahy, 1 ♂, 1 ♀; Maranhão, São João dos Patos, 3 ♂, 1 ♀; Matto Grosso, Chapada, 1 ♂, 1 [♀], 1 (?) ; Tapirapóan, 1 "♂" [= ♀?]; "Brazil," 2 (?) . ARGENTINA: Iguazú, 1 ♂, 2 ♂¹, 1 ♀¹; Eldorado, 1 ♂¹. PARAGUAY: east of Caaguasú, 3 ♂, 1 ♀; east of Yhú, 1 ♂; Paso Yuvay, 1 ♂. "Bogotá," (errore), 2 ♀.

C. c. colonus ?.—ECUADOR: Zamora, 4 ♂, 5 ♀.

C. c. niveiceps.—PERÚ: Poco Tambo (= Pucatambo), 2 ♂¹ (incl. type); Moyobamba, 1 ♂¹; Río Seco, west of Moyobamba, 4 ♂; Uchco, 1 ♂; La Merced, 2 ♂, 1 ♀; Perené, 1 ♂; Tulumayo, 3 ♂, 1 "♂" [= ♀?]; Lagarto, Río Ucayali, 1 ♀; Pachiza, 1 ♂, 1 ♀; Río Távares, 1 ♂; Río Colorado, Chanchamayo, 1 ♂¹, 4 ♀¹; San Ramón, 1 ♂¹, 1 ♀¹. BOLIVIA: Río Huayna Choirisa, 1 ♂; Lower Beni, 1 [♂].

C. c. fuscicapilla.—ECUADOR: Río Suno, above Avila, 3 ♂, 3 ♀; below San José, 1 ♂, 1 ♀; mouth of Río Curaray, 2 ♂, 3 ♀; Archidona, 1 ♂; "Napo," 1 ♂. COLOMBIA: Villavicencio, 1 ♂, 1 ♀; Buena Vista, 2 ♂; Mambito, 1 ♂, 1 ♀; "Bogotá," 2 ♂, 4 ♀, 1 [♀]¹.

C. c. poecilnota.—DUTCH GUIANA: near Paramaribo, 1 ♂. BRITISH GUIANA: Conwarook, 2 ♀¹.

C. c. leuconota.—ECUADOR: Río de Oro, 2 ♂, 1 ♀; Esmeraldas, 2 ♂; Quevedo, 2 ♂; Pambilar, 1 ♂; Cachabí, 1 ♂. COLOMBIA: "Bogotá," 2 [♂], 1 [♀]; Gaupi, 1 ♂; Puerto Berrio, 1 ♀; Barbacoas, 1 ♂, 1 (?) ; San José, Cauca, 3 ♀; Los Cisneros, 2 ♀; Honda, 1 ♂; within twenty miles of Honda, 2 ♂, 1 (?) ; Noanamá, 1 ♂; Baudó, 1 ♀; Alto Bonito, 1 ♂, 1 ♀, 1 (?) ; Río Dagua, 1 ♂; Yuntas, 2 ♂, 1 ♀; Quibdó, 1 ♀¹; Cerro Munchique, 1 ♂¹, 1 ♀¹. PANAMÁ: 12 ♂, 9 ♀, 2 (?) , 2 (?) ¹. COSTA RICA: 4 ♂, 1 (?) , 2 ♂¹, 3 ♀¹. NICARAGUA: 9 ♂, 1 (?) .

Knipolegus orenocensis sclateri Hellmayr

Knipolegus sclateri HELLMAYR, 1906 (July), Novit. Zool., XIII, p. 319—Rio Madeira [below the mouth of the Rio Mahissy (? = Rio Marcy)], Brazil; ♂; Vienna Mus.

I have eight males and a female from Santo Antonio de Guajará, left bank of the lower Rio Madeira, which are referable to this upper Amazonian form. Curiously, neither Pelzeln nor Hellmayr makes any mention of a broad, pinkish cinnamon inner margin on the remiges of the female which is a prominent characteristic of the specimen of that sex now before me. However, Dr. Hellmayr writes me that the female in the Vienna Museum, from the type locality, has these same markings which he had duly recorded in his manuscript notes but which he had omitted to mention in his published account. He also advises me that three females of *xinguensis*, of which I have only males, lack these well-defined edges. They are quite lacking in males of both forms.

There are faint traces of pale inner margins on the remiges of female

¹ Specimens in Field Museum of Natural History, Chicago.

orenocensis, but they are far from the strong borders shown by female *sclateri*. In general respects, the females of *sclateri* and *zinguensis* (as described) resemble each other more than they suggest *orenocensis*, while the males of *orenocensis* and *zinguensis* are closer to each other than to the same sex of *sclateri*.

A single record of a male of *sclateri* from Pebas (specimen in the British Museum) carries the distribution of this form into Perú, but additional records would be desirable.

SPECIMENS EXAMINED

K. o. orenocensis.—VENEZUELA: Capuchin, 1 ♂; Altagracia, 4 ♂, 4 ♀; Ciudad Bolívar, 2 ♂; Agua Salada de Ciudad Bolívar, 1 ♀.

K. o. zinguensis.—BRAZIL: Goyaz, Rio Araguaya, 2 ♂.

K. o. sclateri.—BRAZIL: Rio Madeira, Santo Antonio de Guajará, 8 ♂, 1 ♀.

Phaeotriccus poecilocercus (Pelzelin)

Empidochanes poecilocercus PELZELN, 1868, 'Orn. Bras.,' II, p. 181—Rio Amazon [= Rio Anajahú, near the mouth of the Rio Branco?], Brazil; Vienna Mus.; = ♀.

Cnipolegus pusillus SCLATER AND SALVIN, 1873, 'Nomen. Av. Neotrop.,' p. 158—Lower Amazon; British Mus.; = ♂.

A female from Sarayacu, lower Río Ucayali, furnishes the first record of this species from Perú.

There is much variation among the females from various localities as regards the brown or olive coloration of the upper parts and breast, the whiteness or yellowness of the belly, and the intensity of rufescence on the tail, but I can find no geographic significance in these factors. The Peruvian specimen is intermediate. The males show little variation of any kind. Young males are much like the adult females but are grayer in tone.

SPECIMENS EXAMINED

P. poecilocercus.—VENEZUELA: Río Orinoco, Perico, 1 ♂; mouth of Río Ocamo, 1 ♀. BRAZIL: Rio Negro, Yavanari, 1 ♂; Tabocal, 1 ♀; Muirapinima, 2 ♂; Igarapé Cacao Pereira, 1 ♂, 2 ♀; Faro, 12 ♂, 2 ♀, 1 (?) ; Monte Alegre, 1 ♂; Rio Tocantins, Arumatheua, 1 ♂; Alcobaça, 1 ♂; Rio Tapajoz, Caxiricatuba, 3 ♂, 2 ♀; Piquiatuba, 1 ♂; Inajatuba, 2 ♂; Tauary, 2 ♀; Igarapé Amorin, 1 ♀; Itaituba, 1 ♀; Villa Bella Imperatriz, Lago Andará, 2 ♂; Boca Rio Andará, 1 ♀; Rio Madeira, Borba, 1 ♂; Rosarinho, 4 ♂, 2 ♀; Jamarysinho, Rio Machados, 1 ♂. PERÚ: Sarayacu, Río Ucayali, 1 ♀.

Fluvicola pica albiventer (Spix)

Muscicapa albiventer SPIX, 'Av. Bras.,' II, p. 21, Pl. xxx, fig. 1; part, descr. of male—Brazil; Munich Mus.

I have no Peruvian specimens of this species which is included in the Peruvian list on the basis of a female from Pebas, now in the British Museum, and a specimen collected by Bartlett on the "Upper Ucayali" (near Cashiboya?), the present repository of which is unknown.

The references to these specimens have been subject to some confusion. Selater and Salvin originally recorded the upper Ucayali specimen as *pica* and the Pebas specimen as "*albiventris*" but later included both under *pica*. Shortly afterward, Taczanowski cited both records under *pica*, apparently following Selater and Salvin's latest treatment, accompanying the citation with a description of true *pica*, which was not necessarily drawn up from the Peruvian specimens. Still later, Selater listed the Pebas specimen under "*albiventris*," together with the original record for it under this name, but under *pica* he included the references to the same specimen (as well as the Ucayali references) under that name although no Peruvian specimen of *pica* is listed. The various records obviously are quoted here under the names as variously applied in previous papers, without proper analysis.

Mr. J. D. Macdonald of the British Museum kindly writes me that the Pebas specimen is properly referable to *albiventer*, and I strongly suspect that the Ucayali specimen belonged to the same form. The range of *pica* is almost exclusively in the northern part of South America and reaches the Amazonian drainage only, so far as known, on the upper Rio Branco. On the other hand, *albiventer* occurs on the Rio Madeira and both banks of the lower Amazon, as well as in other parts of southern and eastern Brazil, Paraguay, and Argentina, and with the definite record of this form from Pebas, the Ucayali record may be assigned to *albiventer* without much hesitation. There still remains, however, a hiatus in the range between eastern Perú and the Rio Madeira, Brazil, where future field work should uncover the presence of this subspecies.

Ramphotrigo ruficauda (Spix)

Platyrhynchus ruficauda SPILX, 1825, 'Av. Bras.,' II, p. 9, Pl. XI, fig. 1 "in sylvis fl. Amazonum"; Munich Mus.

There are said to be four specimens of this species, one male and three females, in the British Museum, collected at Chamicuros, Perú, by Hauxwell and Bartlett. These are the only Peruvian examples recorded. Our collectors failed to obtain the bird in Perú although we have an excellent series of ninety-one specimens from other parts of its range where it appears to be not very rare. The nearest approach to Peruvian territory in this series are Tefé, Brazil, on the south bank of the Amazon, and

Mt. Curycuryari, on the upper Río Negro. On the Río Uaupés, the species enters Colombia opposite Tahuapunto, Brazil. On Mt. Curycuryari, the range extends upwards to some 2500 feet, and on Mt. Duida at least to 2000 feet.

***Ramphotricon fuscicauda* Chapman**

Ramphotricon fuscicauda CHAPMAN, 1925 (September 28), Amer. Mus. Novitates, No. 187, p. 5—Lower Río Suno, Ecuador; ♀; Amer. Mus. Nat. Hist.

A second female specimen of this rare species, heretofore known only from the type, is at hand from Lagarto, upper Ucayali, extending the range of the species far to the southward, though with no indication of the line of communication between the two known localities if, indeed, such communication exists.

The Peruvian skin is very like the type though with a slightly warmer hue on the wing-bars. Except for the yellow, instead of rufescent, crissum and a somewhat deeper tone of yellow on the belly, the under parts of the body are strikingly similar to *R. ruficauda*. The upper parts likewise are very similar, although the general hue is a somewhat more brownish olive, with the top of the head rather distinctly darker and with the uropygium like the mantle instead of rufescent. The outer rectrices are pronouncedly shorter than the others (8 mm. shorter than the median ones in the Lagarto skin; 5 mm. in the type) whereas, in *ruficauda*, the difference is slight and in some cases with the outer feathers the longest. The tips of the rectrices have rather definitely defined pale tips as well as olivaceous outer margins. Wing and tail are slightly longer in the Lagarto specimen than in the type, being 70.5 and 67 mm., respectively; in the type the wing is 68 mm. and the tail 65. The pale eye-ring and pale upper margin of the lores are as in *ruficauda*. The generally dark appearance of the wings and tail and the olive-green upper tail-coverts and yellow crissum as compared with the strong cinnamonaceous color of the same regions in *ruficauda* are instantly diagnostic. Nevertheless, when more is known about the Peruvian distribution of the two forms some relationship closer than generic may become apparent. At present the two must be treated as species.

AMERICAN MUSEUM NOVITATES

Number 931

Published by
THE AMERICAN MUSEUM OF NATURAL HISTORY
New York City

June 29, 1937

AFRICAN MUSCIDAE.—IV (DIPTERA)

By C. H. CURRAN

In this contribution keys are contained for the identification of several genera of Muscidae, together with notes and descriptions. Unless otherwise stated the types are in The American Museum of Natural History.

LISPE LATREILLE

LATREILLE, 1796, 'Prec. d. Caract. génér. d. Ins.,' p. 169.

BECKER, 1904, Zeits. Ent., Breslau, XXIX, pp. 1-70.

ALDRICH, 1913, Journ. N. Y. Ent. Soc., XXI, p. 126.

During recent years the name of this genus has been spelled *Lispa*, following Becker, instead of *Lispe* as originally proposed. In 1904, Becker reviewed the Palaearctic species, many of which occur in Africa, and in 1913, Aldrich revised the North American species. The genus may be easily recognized by the spatulate palpi and the presence of hairs on the middle of the pteropleura, this part of the thorax being otherwise bare.

In the preparation of the following key to the species recorded from Africa I have had to rely to a large extent upon descriptions and have omitted most of the species occurring in North Africa and those too poorly described to be included.

TABLE OF SPECIES

- | | |
|---|-----------------------------|
| 1.—Femora black..... | 2. |
| Femora yellow..... | <i>flavipes</i> Stein. |
| 2.—Palpi black..... | 3. |
| Palpi reddish or yellowish..... | 7. |
| 3.—Apical tarsal segments black..... | 4. |
| Fourth segment of anterior tarsi reddish yellow..... | <i>kowarzi</i> Becker. |
| 4.—Abdomen shining black, with white spots..... | <i>nivalis</i> Wiedemann. |
| Abdomen pale pollinose, with black spots..... | 5. |
| 5.—Antennae reaching only a little below the middle of the face..... | <i>candicans</i> Kowarz. |
| Antennae reaching almost to the vibrissae..... | 6. |
| 6.—Front tibiae with a bristle near the middle; second segment of the anterior tarsi of the male with a small tubercle..... | <i>tuberculiarsis</i> Stein |
| Front tibiae without bristle; anterior tarsi simple..... | <i>armipes</i> Becker. |
| 7.—Fourth vein strongly curved forward apically..... | 8. |
| Fourth vein straight or slightly curved..... | 12. |

- 8.—Middle tibiae with two bristles near the middle. 9.
 Middle tibiae with only one bristle near the middle. 10.
 9.—First segment of the posterior tarsi long haired; posterior femora without ventral bristles. *ciliatarsis* Loew.
 Posterior tarsi without long hair; posterior femora with a median and preapical anteroventral bristle. *longicollis* Meigen.
 10.—Middle femora with long hair ventrally on basal half. *nuba* Wiedemann.
 Middle femora with short bristles or two very long ones below. 11.
 11.—Middle femora with short bristles below. *modesta* Stein.
 Middle femora with two very long, stout bristles below. *barbipes* Stein.
 12.—Two equally long and strong presutural dorsocentrals. 13.
 One long and strong presutural or two or three weak ones. 17.
 13.—Parafacials with a strong bristle below. *micochaeta* Speiser.
 Parafacials without strong bristle below. 14.
 14.—Middle tibiae with a single bristle in addition to the apical ones. 15.
 Middle tibiae with two bristles in addition to the apical ones. 16.
 15.—Parafacials with a row of fine, short bristles. *biseta* Stein.
 Parafacials with ordinary hair. *nana* Macquart.
 16.—Abdomen with paired spots above; parafrontals brownish yellow. *ambigua* Stein.
 Abdomen without paired dorsal spots; parafrontals gray. *surda*, n. sp.
 17.—Abdomen shining black, with roundish white spots on the basal half of the segments; tibiae black. *maculata* Stein.
 Abdomen either with a continuous broad cinereous vitta laterally or cinereous with blackish markings. 18.
 18.—Frontal vitta reaching the anterior border of the front. 19.
 Frontal vitta not nearly reaching the anterior border of the front; parafrontals broadly shining black above. *irvingi*, n. sp.
 19.—Middle tibiae with two bristles in addition to the apical ones. *dichaeta* Stein.
 Middle tibiae with a median, posterior bristle. 20.
 20.—Abdomen with a broad brown vitta below the sides of the dorsum.
leucospila Wiedemann.
 Abdomen with the under surface cinereous. *afra*, n. sp.

Lispe flavipes Stein

STEIN, 1913, Ann. Mus. Nat. Hung., XI, p. 542.

Described from Cape Colony. I have not seen the species but it should be readily recognized by its reddish-yellow femora.

Lispe kowarzi Becker

BECKER, 1903, Mitt. Zool. Mus. Berlin, II, p. 116.

I have no African specimens before me but there are four from Formosa, named by Stein, in the Museum collection.

Lispe nivalis Wiedemann

WIEDEMANN, 1830, 'Ausser. Zweifl.,' II, p. 659.

Lispe lineata MACQUART, 1838, 'Hist. Nat. Isl. Canar.,' II, pt. 13, p. 116 (Canary Islands).

Lispe elephantina BECKER, 1903, Mitt. Zool. Mus. Berlin, II, p. 117 (Egypt).

Two males and four females, East London, S. Africa, November 18, 1923 and February 27, 1925; two males and one female, Bedford, S. Africa, February 7, 1925; male, Middleburg, S. Africa, February 13, 1925; female, Uitenhage, S. Africa, March 11, 1919; male, Barberton, Transvaal, October 7, 1919; male and two females, Pretoria, Transvaal, December 22, 1912 and December 16, 1913 (H. K. Munro); male, Bloemfontein, Orange River Province, May 23, 1920 (H. E. Irving); male, Balla Balla, S. Rhodesia, May, 1931; two males, three females, Lomagundi, S. Rhodesia, July 11, 1932 (A. Cuthbertson).

Lispe candicans Kowarz

KOWARZ, 1892, Wien. Ent. Zeitz., XI, p. 36 (Europe).

BECKER, 1903, Mitt. Zool. Mus. Berlin, II, p. 112 (Egypt).

Stein has reported the species from Mozambique but I have seen no specimens from Africa.

Lispe tuberculitarsis Stein

STEIN, 1913, Ann. Mus. Nat. Hung., XI, p. 346.

Described from East Africa and Natal.

Lispe armipes Becker

BECKER, 1903, Mitt. Zool. Mus. Berlin, II, p. 118 (Egypt).

Male and female, East London, S. Africa, February 26, 1925 (H. K. Munro).

Lispe cilitarsis Loew

LOEW, 1856, 'Neue Beitr.', IV, p. 49.

Two males, Bloemfontein, May 23, 1920; male, Vryburg, South Africa, September 7, 1920 (H. E. Irving); male, Uitenhage, South Africa, March 3, 1919 (H. K. Munro).

Loew described the species from Egypt.

Lispe longicollis Meigen

MEIGEN, 1826, Syst. Besch. Eur. Dipt., V, p. 225 (Europe).

STEIN, 1913, Ann. Mus. Nat. Hung., XI, p. 548.

This European species was reported from Cape Colony by Stein.

Lispe nuba Wiedemann

WIEDEMANN, 1830, Ausser. Zweifl., II, p. 444.

Lispe dissimilis MACQUART, 1850, Dipt. Exot., Suppl. IV, p. 264 (Egypt).

Lispe dissimilis BECKER, 1904, Zeits., Ent. Breslau, XXIX, p. 15.

CURRAN, 1928, Bull. Amer. Mus. Nat. Hist., LVII, p. 352.

Three males and a female from the Belgian Congo.

Lispe barbipes Stein

STEIN, 1908, Denkschr. Med. Nat. Ges., p. 171.

A single male, Bloemfontein, May 23, 1920 (H. E. Irving).

Lispe modesta Stein

STEIN, 1913, Ann. Mus. Nat. Hung., XI, p. 551.

Described from Dembelsee. I have not seen this form.

Lispe miochaeta Speiser

SPEISER, 1910, 'Kil.-Meru Exp.,' X, p. 164.

I have not seen this species, described from East Africa.

Lispe surda, new species

Related to *ambigua* Stein but distinguished in both sexes by the absence of brown dorsal spots on the abdomen. Length, 7 mm.

MALE.—Head black, cinereous pollinose, vertex and frontal triangle with brownish tinge; interfrontalia appearing black from dorsal view, brownish from front. Six pairs of frontals, the upper two reclinate; parafrontals with a row of short hairs and with a second row anteriorly; ocellars and outer verticals long. Cheeks a little less than one-third as wide as the eye-height. Parafacials wide, haired on the whole surface. Palpi yellow, white pollinose, very broad on the apical half. Antennae black, the apex of the second segment red, white pollinose; third segment but little longer than the elongate second; arista with moderately long black rays.

Thorax black, greenish-gray pollinose, the disc of the mesonotum and a triangle on the mesopleura brownish; scutellum greenish gray with the disc more or less brown. Acrosticals, anterior intra-alar and prealar bristles absent; dorsocentrals 2-2; sternopleurals arranged in a triangle, the lower sides of which are about equal.

Coxae and femora black, gray pollinose; tibiae reddish; tarsi blackish with the basal segment almost wholly reddish. Posterior trochanters with the apical surface densely clothed with short, rather coarse, appressed black setulae; anteroventral and posteroventral surfaces of the middle femora each with four black bristles on the basal half, the posterior femora with about seven on the basal two-thirds of these surfaces and with several long bristly hairs at the base. Anterior tibiae with only apical bristles, the median pair with an anterodorsal and posterodorsal bristle beyond the middle; posterior tibiae with a long posterior bristle beyond the middle. Tarsi simple.

Wings cinereous hyaline, yellowish basally; fourth vein not curved apically. Squamae whitish, with yellow border. Halteres yellow.

Abdomen black in ground color, gray pollinose, on the dorsum with a greenish tinge in the middle, without paired spots on the dorsum, the under surface with an incomplete, broad, pale brownish vitta on either side, interrupted at the segmental sutures. Hair black. Fifth sternite with a broad V-shaped apical emargination; posterior forceps reddish.

FEMALE.—Parafrontals inclined to be blackish anteriorly; two pairs of the frontal bristles weak. Palpi less broadened. Mesonotum inclined to be vittate. Posterior trochanters simple; middle femora with four short posteroventral bristles

and a long, fine basal one, the anteroventral bristles absent; posterior femora without bristles ventrally but with four or five long, bristly hairs on the anterior surface at the base, one of them ventral.

Types.—Holotype, male, allotype, female, and one paratype, female, Bloemfontein, Orange River Province, May 30, 1920 (H. E. Irving). The types will be returned to Mr. H. K. Munro.

This species has the posterior trochanters much more extensively setose than in *ambigua* and the emargination of the fifth sternite is evidently larger. In *ambigua* the segments each bear a pair of elongate, subshining brown spots dorsally and a darker, lateral row of spots on the sides of the under side.

Lispe ambigua Stein

STEIN, 1913, Ann. Mus. Nat. Hung., XI, p. 545.

A single male, Addis Abbaba, Abyssinia, August 12, 1920 (B. Brown).

The specimen has the base of the fourth sternite conically produced forward in the middle, but whether the character is a normal development or not can only be determined by the examination of a series of specimens. The posterior trochanters are densely black setose below and the abdomen bears on the upper part of the lower surface a row of broad brownish spots.

Lispe biseta Stein

STEIN, 1913, Ann. Mus. Nat. Hung., XI, p. 543.

Described from East Africa.

Lispe nana Macquart

MACQUART, 1835, 'Hist. Nat. Dipt.,' II, p. 314 (Europe).

BECKER, 1904, Zeitschr. Ent. Breslau, XXIX, p. 32.

Female, Pretoria, Transvaal, February 27, 1915 (H. K. Munro).

Lispe maculata Stein

STEIN, 1913, Ann. Mus. Nat. Hung., XI, p. 547 (Rhodesia).

Male, Barberton, Transvaal, May 23, 1913 (H. K. Munro); female, Balla Balla, S. Rhodesia, March, 1931 (A. Cuthbertson); three females, Addis Abbaba, Abyssinia, July 18, and August 31, 1920 (B. Brown).

Lispe leucospila Wiedemann

Coenosia leucospila WIEDEMANN, 1830 Ausser. Zweifl., II, p. 441 (E. Indies).

Lispa pectinipes BECKER, 1903, Mitt. Zool. Mus. Berlin, II, p. 113 (Egypt).

Lispa lateralis STEIN, 1906, Berl. Ent. Zeitschr., LI, p. 70 (Delagoa Bay).

STEIN, 1913, Ann. Mus. Nat. Hung., XI, p. 549.

Male, New Hanover, Natal, December 1, 1914 (C. B. Hardenberg); sixteen males and twenty-one females, Barberton, Transvaal, May 5, 15, 17, 21 and 22, 1913; two males, Pretoria, Transvaal, May 13, 1917

(H. K. Munro); male, Rustenburg, Transvaal, January 18, 1921 (collector ?); female, Hartley, S. Rhodesia, November, 1930, (collector ?); male, Salisbury, S. Rhodesia, September, 1929; female, Balla Balla, S. Rhodesia, March, 1931 (A. Cuthbertson).

Lispe irvingi, new species

Related to *leucospila* Wiedemann but the posterior tibiae bear long, fine hairs on most of the length of the ventral surface instead of on only the apical half. Length, 6 mm.

MALE.—Head black in ground color; occiput and cheeks cinereous; face and parafrontals rather golden brownish yellow, the parafrontals broadly shining above. Front opaque black, the narrow, incomplete frontal triangle brownish yellow; six pairs of frontals, the upper two reclinate, the ocellars and outer verticals strong; parafrontals very narrow, with a row of four or five short hairs on the upper half and few finer ones on the anterior third. Checks scarcely one-fifth as wide as the eye-height. Parafacials narrow, slightly widening below and above, with a single row of black setulae. Palpi reddish yellow, of moderate width, with short black hairs on the outer surface. Antennae black, the apex of the second segment and narrow base of the third reddish; third segment almost twice as long as the second; arista moderately long plumose.

Thorax black, the mesonotum and mesopleura yellowish-brown pollinose, the pleura cinereous; scutellum brown with the sides cinereous. Dorsocentrals 1-4, the anterior two pairs of postsuturals short and weak; sternopleurals 1-2.

Legs black, the tibiae reddish on the posterior four legs, the front legs missing; femora and coxae cinereous pollinose. Middle femora with an entire row of short, fine posteroventral bristles which become dense just before the apex and with a row of similar bristles on the anteroventral surface which are shorter and finer on the apical sixth, the anterior surface with an outstanding bristle before the middle; posterior femora with a row of about six fine, anteroventral bristles on the basal half and fine, erect hair basally on the posterior and posteroventral surfaces. Middle tibiae with a posterior bristle near the basal third; posterior tibiae with a row of long hairs on the apical two-thirds of the anteroventral surface and two or three rows on at least the apical three-fourths of the posteroventral surface. Tarsi simple, the basal segment of the middle pair except the apex, and the basal half of the second and third segments, reddish.

Wings cinereous hyaline; fourth vein not curved forward. Squamae white, the lower lobe with pale yellowish border. Halteres reddish yellow.

Abdomen cinereous, the dorsum with blackish-brown markings. First segment with an oval, longitudinally placed median brown spot which unites with a broad, incomplete basal fascia; second segment with a pair of anteriorly united brown triangles which occupy most of the segment and are concave on the oblique anterior border; third segment with similar brown markings; fourth segment with a broad median vitta which widens and joins a posterior fascia, brown. Under surface cinereous except the posterior border of the fourth segment. Genitalia shining black. Hair black; segments each with a median lateral bristle.

TYPE.—Male, Bloemfontein, Orange River Province, May 30, 1920 (H. E. Irving); returned to Mr. H. K. Munro.

This species is slender and bears a strong superficial resemblance to *leucospila* Wiedemann. I have not seen the female but it will no doubt be easily recognized by the entire absence of the brown vittae on the under side of the abdomen. The anterior tibiae probably bear a posterior bristle near the middle as is the case in *leucospila*.

***Lispe dicaeta* Stein**

STEIN, 1913, Ann. Mus. Nat. Hung., XI, p. 544.

Stein described this species from Natal but it is not among the rich South African material before me.

***Lispe afra*, new species**

Scutellum black in the middle except at the extreme base; abdomen with blackish spots on second and third segments and large spot on the fourth; palpi moderately broad, yellowish. Length, 6.5 mm.

FEMALE.—Head black, cinereous white pollinose; front black, the orbits cinereous, frontal triangle pale brown, narrow, reaching the anterior border of the front; the interfrontalia appearing brown from anterior view; seven pairs of frontals, the upper two reclinate; parafrontals narrow, with a row of very short, fine hairs on the anterior half and a second row on the anterior fourth. Cheeks scarcely one-fifth as wide as the eye-height. Parafacials moderately narrow, with scattered fine black hairs. Palpi reddish yellow, moderately widened apically, the outer surface with coarse black hairs, the apex with two or three bristles. Antennae black; apex of second segment reddish, white pollinose; third segment decidedly longer than the second; arista moderately long plumose on the basal three-fifths.

Thorax cinereous pollinose, with five brownish vittae, the median one wide and reaching the scutellum obscurely, the scutellum brown with a large cinereous triangle on either side. Prescutellar acrostical bristles weak; dorsocentrals 1-4, the anterior two pairs of postsuturals short; sternopleurals 1-2.

Legs blackish, cinereous pollinose; posterior four tibiae and the anterior pair on the basal fourth or more, reddish. Middle femora with a row of short, rather fine anterior bristles on the basal fourth and with a strong posterodorsal bristle at the apical fifth in addition to the usual preapical; posterior femora with an anteroventral bristle near the middle and with an entire anterodorsal row. Anterior tibiae with a strong posterior bristle at the middle, the middle tibiae with a strong posterodorsal bristle before the middle; posterior tibiae with one anterodorsal and one anteroventral bristle. Tarsi simple.

Wings cinereous hyaline; fourth vein not curved apically. Squamae white with yellow border. Halteres reddish yellow.

Abdomen cinereous; second and third segments each with a very large, subshining brownish black spot leaving a median vitta and the base toward either side, cinereous, the apex of the third segment also broadly cinereous; fourth segment with a much smaller pair of spots which are only obscurely divided by a median vitta and do not extend so strongly toward the lateral margins. Hair black, each segment with a lateral discal.

TYPE.—Female, Vryburg, S. Africa, September 4, 1920 (H. E. Irving); returned to Mr. H. K. Munro.

CATALOGUE AND SYNONYMY

- cochlearia* BECKER, 1904, Zeitschr. Ent., Breslau, XXIX, p. 32 (Egypt).
desjardinsii MACQUART, 1850, Dipt. Exot., Suppl., IV, p. 264 (Mauritius).
dissimilis MACQUART = *nuba* WIEDEMANN.
elephantina BECKER = *nivalis* WIEDEMANN.
halophora BECKER, 1903, Mitt. Zool. Mus. Berl., II, p. 116 (Egypt).
hirtibasis BIGOT, 1884, Ann. Soc. Ent. France, p. 292 (Cape).
hottentota BIGOT, 1884, Ann. Soc. Ent. France, p. 293 (Cape).
hirtitarsis STEIN, 1918, Ann. Mus. Nat. Hung., XVI, p. 197 (Reunion and Bourbon).
hottentota BIGOT = *hirtibasis* BIGOT.
lateralis STEIN = *leucospila* WIEDEMANN.
leucocephala LOEW, 1856, Neue Beiträge, IV, p. 49 (Egypt).
leucosticta STEIN, 1918, Ann. Mus. Nat. Hung., XVI, p. 198 (Madagascar).
lineata MACQUART = *nivalis* WIEDEMANN.
maculifrons MACQUART = *pygmaea* FALLÉN.
neo MALLOCH, 1922, Ann. Mag. Nat. Hist., X, p. 390 (Ashanti, Gambia).
niveimaculata STEIN. See *Xenolispa*.
ochracea BECKER, Denkschr. Akad. Wien., LXXI, p. 150 (Africa). I could not locate this description: the reference is from Stein's 'Catalogue.'
pectinipes BECKER = *leucospila* WIEDEMANN.
pennitarsis STEIN, 1918, Ann. Mus. Nat. Hung., XVI, p. 198
pygmaea FALLÉN, 1825, Musc., p. 94 (Europe).
(*Hylemyia*) *maculifrons* MACQUART, 1851, Dipt. Exot. Suppl., IV, p. 265 (Egypt).
metatarsalis THOMSON, 1868, Eugenes Resa, Dipt., p. 562.
remipes BECKER, 1913, Wien. Ent. Ztg., XXXII, p. 126 (Africa).
rigida BECKER, 1903, Mitt. Zool. Mus. Berlin, II, p. 115 (Egypt).
scalaris LOEW, 1847, Stett. Ent. Ztg., VIII, p. 28 (Africa).
Seznnotata MACQUART, 1843, Dipt. Exot., II, part 3, p. 167 (Bourbon).
simonyi BECKER, 1910, Denkschr. Akad. Wien., LXXI, p. 151. (See note under *ochracea* in catalogue.)
spinipes BIGOT. See *Lamphora*.
tentacula DEGEER, 1776, (Musca), 'Ins.', VI, p. 86 (Europe).
tibialis MACQUART, 1843, 'Dipt. Exot.', II, part 3, p. 166 (Camaric).
tibialis MACQUART = *tentacula* DEGEER.

XENOLISPA MALLOCH

MALLOCH, 1922, Ann. Mag. Nat. Hist., X, p. 391.

This genus was established for four Asiatic species, no genotype being named. The genus is distinguished from *Lispe* by the presence of only a single pair of dorsocentral bristles situated immediately in front of the scutellum. *Coenosia pumila* Wiedemann may be taken as the genotype.

***Xenolispa niveimaculata* Stein**

- Lispa niveimaculata* STEIN, 1906, Berl. Ent. Zeitschr., LI, p. 68 (E. Africa).
Lispa niveimaculata STEIN, 1913, Ann. Mus. Nat. Hung., XVI, p. 548 (Natal).

Male, Chirinda Forest, S. Rhodesia, November, 1930 (A. Cuthbertson); male, Paiata, Liberia, October, 1926; male and female, Du River Camp No. 3, Liberia (J. Bequaert).

DIMORPHIA MALLOCH

MALLOCH, 1922, Ann. Mag. Nat. Hist., IX, p. 273. (Type *Cyrtoneura flavicornis* MACQUART.)

The key which follows contains all the species recorded from Africa.

TABLE OF SPECIES

- 1.—Antennae and palpi wholly yellowish or reddish.....2.
At least the third antennal segment mostly black.....4.
 - 2.—Fourth wing vein strongly curved forward apically and ending only a little behind the wing-tip.....3.
Fourth vein only gently curved forward and ending far behind the wing-tip.
latifrons Malloch.
 - 3.—Mesonotum yellow, with one or three black vittae.....*setulosa* Stein.
Mesonotum dark in ground color, cinereous yellow pollinose, with four more or less distinct olivaceous vittae.....*flavicornis* Macquart.
 - 4.—Palpi black or brown, the bases sometimes paler.....5.
Palpi wholly reddish.....*subpunctata* Walker.
 - 5.—Abdomen yellow, a median vitta and disc of third and fourth segments blackish in ground color; pleura yellow.....*tristis* Wiedemann.
Abdomen blackish in ground color, the first and second segments sometimes partly yellow.....6.
 - 6.—Pleura mostly yellowish.....*fusciventris* Malloch.
Pleura wholly blackish.....7.
 - 7.—Humeri reddish yellow.....*humeralis*, new species.
Humeri black in ground color.....8.
 - 8.—Mesonotum rather thinly pollinose, the outer black vittae very broad.
obscura, new species.
- Thorax densely cinereous pollinose, the vittae narrow.....*thoracica*, new species.

Dimorphia setulosa Stein

Mydaea setulosa STEIN, 1918, Ann. Mus. Nat. Hung., XVI, p. 192 (Natal).

Dimorphia flavithorax MALLOCH, 1922, Ann. Mag. Nat. Hist., IX, p. 274 (Natal).

Dimorphia flavithorax MALLOCH, 1929, Ann. Mag. Nat. Hist., IV, p. 108 (British E. Africa).

Two males, East London, Cape Province, May 12, 1923 and June 26 1924; female, Barberton, Transvaal, October 8, 1919 (H. K. Munro); female, Port Alfred, Cape Province, January, 1918 (R. O. Wahl); female, Vumba, S. Rhodesia, Nov., 1932.

The female from Vumba has a black mesonotal vitta as in the males.

Dimorphia flavicornis Macquart

Cyrtoneura flavicornis MACQUART, 1843, Dipt. Exot., II, pt. 3, p. 156 (Mauritius).

- Spilogaster translucens* STEIN, 1906, Berl. Ent. Zeitschr., LI, p. 48 (Madagascar).
Mydaea flavicornis STEIN, 1913, Ann. Mus. Nat. Hung., XI, p. 501 (E. Africa).
Mydaea ochrocera STEIN, 1913, Ann. Mus. Nat. Hung., XI, p. 501 (Mauritius).
 MALLOCH, 1922, Ann. Mag. Nat. Hist., IX, p. 273.
 MALLOCH, 1929, Ann. Mag. Nat. Hist., IV, p. 108.

Male and female, Barberton, Transvaal, May 20, 1914 and October 5, 1919 (H. K. Munro); female, New Hanover, Natal, November 16, 1914 (C. B. Hardenberg); male, Victoria Falls, August 30, 1920 (H. E. Irving); four males, Bindura, S. Rhodesia, March, 1932; two males and 3 females, Salisbury, S. Rhodesia, August, 1929, May 9, 1932 and September 20, 1932; male and female, Balla Balla, S. Rhodesia, March, May, 1931; female, Lomagundi, S. Rhodesia, August 12, 1932 (A. Cuthbertson); female, Salisbury, S. Rhodesia, September, 1929; male, Chirinda Forest, S. Rhodesia, November, 1930 (A. Cuthbertson).

Dimorphia subpunctata Walker

- Anthomyia subpunctata* WALKER, 1856, Dipt. Saunders, p. 353.
Spilogaster latevittata BIGOT, 1884, Ann. Soc. Ent. France, p. 286.
Mydaea latevittata STEIN, 1906, Berl. Ent. Zeitschr., LI, p. 46.
Mydaea subpunctata STEIN, 1913, Ann. Mus. Nat. Hung., XI, p. 500.
Dimorphia tristis MALLOCH, 1922, Ann. Mag. Nat. Hist., IX, p. 273.
Dimorphia tristis MALLOCH, 1929, Ann. Mag. Nat. Hist., IV, p. 108.

Male and female, Port Shepstone, Natal, August 18, 23, 1920; two males, East London, Cape Province, May 5, 1923 and April 26, 1924 (H. K. Munro).

Dimorphia tristis Wiedemann

- Anthomyia tristis* WIEDEMANN, 1830, Ausser. Zweifl II, p. 423 (Cape).
Dimorphia nigricornis MALLOCH, 1929, Ann. Mag. Nat. Hist., IV, p. 108.

Male, New Hanover, Natal, December 1, 1914 (C. B. Hardenberg).

Wiedemann's type came from "Cape," while Malloch described *nigricornis* from Natal, Portuguese East Africa and Kenya. Wiedemann's type is before me and does not agree with specimens usually placed as *tristis* but does agree with *nigricornis* of Malloch. Malloch followed Stein in considering *subpunctata* Walker a synonym of *tristis*. *D. subpunctata* is larger, has a more strongly vittate mesonotum and mostly reddish palpi, the ends sometimes being brownish. The antennae are missing in the type of *tristis* but they were evidently reddish basally.

Dimorphia fusciventris Malloch

- MALLOCH, 1929, Ann. Mag. Nat. Hist., IV, p. 109.

The sex of the type of this species is not stated in the original description. Described from Kenya. It is unknown to me.

Dimorphia humeralis, new species

Black, the basal antennal segments, humeri and tibiae reddish. Length, 6.5 to 7.5 mm.

FEMALE.—Head black, thickly cinereous pollinose, the parafacials and parafrontals somewhat silvery. Front wide, the vitta black; ocellar triangle extending to the middle of the front; four or five pairs of frontals, the upper two reclinate, the anterior pair strong; ocellars long and strong; outer verticals half the length of the verticals; occipital hair black. Palpi black. Antennae brown, the two basal segments reddish.

Thorax black, the humeri reddish; pollen moderately thick, cinereous except on the disc of the mesonotum behind the suture where it is yellowish brown. Vittae brownish, narrow, the outer pair interrupted at the suture and curved toward the humeri in front. Two pairs of strong and one or two pairs of weak postsutural dorsocentrals; posterior lower sternopleural widely separated from the upper one. Scutellum reddish brown with the sides more reddish, the pollen grayish brown.

Legs black; apices of the femora, broadly below, the tibiae and the basal two tarsal segments reddish. Anterior tibiae with posterior bristle near the middle.

Wings with strong brown tinge; third vein sometimes with one or two setulae below in addition to those on the stem. Squamae yellowish with darker border. Halteres yellow with the knob somewhat brownish.

Abdomen wholly black, very thinly cinereous pollinose.

TYPES.—Holotype, female, and paratypes, two females, Tiko, Mt. Cameroon, Nigeria, September 1-5, 1935 (Dr. F. Zumpt). Type in Institut für Schiffs-und Tropenkrankheiten, Hamburg.

Dimorphia obscura, new species

Black, the legs partly reddish, the tip of the fourth segment of the female yellowish. Length, 8 mm.

FEMALE.—Head and appendages black; face and occiput thickly cinereous white pollinose; parafrontals less thickly pollinose, the frontal vitta dull black, the triangle with a grayish sheen, reaching to the anterior fourth of the front. Eight pairs of frontals, the upper two reclinate, the anterior pair long and strong; ocellars long. Hair wholly black.

Thorax wholly black in ground color, covered with rather thin cinereous pollen; mesonotum brown pollinose between the dorsocentral black vittae, the outer black vittae much broadened behind the suture so that they reach to the lateral margins. Four pairs of postsutural dorsocentrals. Scutellum brown pollinose with the free border broadly grayish.

Legs black; apices, and apical fifth of the femora on their under surface, reddish; tibiae narrowly reddish basally and at the tips.

Wings with strong brownish tinge; first vein setulose for a short distance beyond the humeral crossvein; stem of second vein setulose on almost its whole length. Squamae pale brownish. Halteres yellow.

Abdomen shining black, thinly covered with cinereous pollen. Tip of fourth segment yellow. Genital lamellae reddish.

TYPES.—Holotype, female, and paratype, female, Mannsquelle, Mt. Cameroon, November 13, 1935 (Dr. F. Zumpt). Type in Institut für Schiffs-und Tropenkrankheiten, Hamburg.

Dimorphia thoracica, new species

Black, the legs mostly reddish; abdomen of male pale orange on basal half; thorax thickly pollinose. Length, 5.5 to 8 mm.

MALE.—Head black, white pollinose, the occiput cinereous or cinereous white. Front twice as wide as the ocellar triangle, the vitta blackish, narrower than parafrenal on the upper half; six or seven pairs of frontals and two or three pairs of bristly hairs above; ocellars long; verticals very weakly differentiated. Occipital hair black. Facial ridges obscurely reddish. Palpi and antennae black; second antennal segment reddish above.

Thorax black, thickly cinereous pollinose, the free border of the scutellum reddish except at the apex. Dorsocentral vittae very narrow and black in front of the suture, wider and brown behind, outer vittae represented by two blackish spots on each side. Three pairs of postsutural dorsocentrals; sternopleurals 1-2.

Legs blackish; apical fourth of posterior four femora and broad apex of the front pair, the tibiae, basal two tarsal segments and the trochanters, reddish.

Wings cinereous hyaline, often with brownish tinge; stem of second vein with two or three setulae below. Squamae and halteres yellow.

First two abdominal segments pale orange, the base of the first, a more or less distinct spot on the middle and the median fourth of the second black in ground color; third and fourth segments black with thick cinereous pollen, the apex of the fourth broadly reddish. Second and third segments each with a pair of broadly separated rather small, roundish brown spots on the posterior half. Genitalia dull reddish.

FEMALE.—Front wide, with six to eight pairs of frontals, the upper two reclinate, the anterior pair long and strong, a pair on the middle of the front sometimes long, the reclinate bristles stout. Verticals and outer verticals long. Outer mesonotal vittae a little more pronounced; free border of the scutellum sometimes all reddish; posterior four femora usually almost all reddish. Abdomen all blackish in ground color and thickly cinereous pollinose, rarely with large yellowish spots on the first segment; paired brown spots much larger than in the male; apex of fourth segment usually more broadly reddish; genital lamellae reddish.

TYPES.—Holotype, male, allotype, female, and paratypes, four males and ten females, Misellele, September 21, 1935, one female, Ekona, October 11, 1935 and female, Tiko, September 25-30, 1935, all on Mt. Cameroon, Nigeria (Dr. F. Zumpt). Type in Institut für Schiffs- und Tropenkrankheiten, Hamburg.

LIST OF SPECIES NOT SEEN AND SYNONYMS

flavithorax MALLOCH = *setulosa* STEIN.

latevitata BIGOT = *subpunctata* WALKER.

latifrons MALLOCH, 1929, Ann. Mag. Nat. Hist., IV, p. 106 (f) (Nyasaland).

nigricornis MALLOCH = *tristis* WIEDEMANN.

ochrocera STEIN = *flavicornis* MACQUART.

translucens STEIN = *flavicornis* MACQUART.

tristis MALLOCH = *subpunctata* WALKER.

ANACLYSTA STEIN

STEIN, 1918, Arch. für Naturg., LXXXIII, Abt. A, Heft 1, p. 138.

No genotype was named for this genus which is apparently a com-

posite group. *Limnophora piliceps* Stein may be considered the type of the genus. It has the eyes densely pilose. All the species have a strong ventral bristle on the middle tibiae beyond the middle. The following table separates the African species placed in the genus by Stein.

TABLE OF SPECIES

1.—Eyes pilose.....	<i>piliceps</i> Stein.
Eyes bare	2.
2.—Palpi yellow.....	<i>flavescens</i> Stein.
Palpi black.....	<i>multipunctata</i> Stein.

Anaclysta piliceps Stein

Limnophora piliceps STEIN, 1913, Ann. Mus. Nat. Hung., XI, p. 514.

Male, Addis Abbaba, Abyssinia, August 31, 1920 (B. Brown). The type series was also from Abyssinia.

Stein described only the female. The male differs considerably from Stein's description.

MALE.—Head black, cinereous pollinose, the parafacials and parafrontals rather silvery. Front wider than the ocellar triangle, widening anteriorly; frontal vitta black, appearing brownish gray from in front; seven or eight pairs of frontals on the anterior three-fifths, the upper ones weak; ocellars long. Cheeks about one-fifth as wide as the eye-height, rather thickly haired. Parafacials of equal width throughout. Palpi and antennae black, the arista pubescent, thickened on the basal fourth. Eyes with thick brownish cinereous pile.

Thorax cinereous pollinose, the mesonotum subshining brown with cinereous markings. Broad lateral margins in front of the wings a pair of broad presutural vittae, the anterior border, a pair of very broad vittae on the posterior third of the mesonotum and a broad stripe above the wings cinereous. Scutellum brown with the apex and sublateral vittae cinereous. Dorsocentrals 2-4; anterior intra-alar absent; prealar absent; prescutellar acrosticals scarcely developed, the acrostical hairs not in rows; two pairs of marginal scutellars, the sides of the scutellum haired on the upper half; sternopleurals 1-2; prosternum, propleura, pteropleura and hypopleura bare.

Legs black, the coxae and femora with cinereous pollen; middle femora with a row of four or five ventral bristles toward the posterior surface on the basal half; posterior femora with a row of anteroventral bristles, the basal ones fine and shorter than those toward the apex, and with a row of fine posteroventral bristles on the basal half. Anterior tibiae with a posterior bristle near the middle, the apex somewhat swollen and bearing a cluster of long, fine hairs on the apical sixth posteriorly; middle tibiae with two posterior bristles and a strong ventral one near the apical third; posterior tibiae with two anterodorsal, anteroventral and posteroventral bristles.

Wings hyaline; fourth vein ending conspicuously before the tip of the wing; third vein bare. Squamae pale yellowish brown. Halteres yellow.

Abdomen black in ground color, densely cinereous pollinose on the apical half, the sides of the second segment broadly yellow in ground color and pale pollinose. First segment opaque black, with a median cinereous vitta. Second segment opaque

black with the sides very broadly, rectangularly produced inwardly on the basal half and a triangular median vitta, cinereous pollinose. Third segment cinereous with a pair of rather small, basal triangles in the middle and large, oval posterior spot toward either side, dull black; fourth segment cinereous with only the sublateral posterior spots opaque black. Venter blackish with rather thick cinereous pollen. Hair wholly black; basal sternite black haired.

In the female the black pattern on the second abdominal segment is broken into four spots and the mesonotum is cinereous with brown vittae.

Anaclysta flavescens Stein

Limnophora flavescens STEIN, 1903, Mitt. Zool. Mus. Berl., II, p. 106.

I have not seen this species which was described from Egypt.

Anaclysta multipunctata Stein

Limnophora multipunctata STEIN, 1903, Mitt. Zool. Mus. Berlin, II, p. 107.

Limnophora pellucida STEIN, 1906, Mitt. Zool., Mus. Berlin, IV, p. 101.

Stein described *multipunctata* from Egypt and *pellucida* from the Canary Islands. The species is unknown to me.

SYNONYMY

Anaclysta pellucida STEIN = *multipunctata* STEIN.

AMERICAN MUSEUM NOVITATES

Number 932

Published by
THE AMERICAN MUSEUM OF NATURAL HISTORY
New York City

June 30, 1937

THE MORPHOLOGY OF WARDITE

FREDERICK H. POUGH

At the time of the study of the phosphate nodules of Fairfield, Utah, in preparation for the recently completed work upon gordonite (Pough, 1937), it was found that several specimens showed what appeared to be good crystals of the mineral wardite ($2\text{Na}_2\text{O} \cdot \text{CaO} \cdot 6\text{Al}_2\text{O}_3 \cdot 4\text{P}_2\text{O}_5 \cdot 17\text{H}_2\text{O}$). The nodules were collected by Arthur Montgomery and Edwin Over in the fall of 1936, reworking the locality from which the original specimens described by Larsen and Shannon (1930) came. As the crystallography of this mineral was not studied in the original descriptions, it was planned to do this, and, at the same time, to bring out the relationship of these crystals to those described by Lacroix (1910) under the name soumansite. The original material of Larsen and Shannon was also examined, but only a few crystallized specimens were found and most of these did not equal those collected by Montgomery and Over.

The crystals occur in vugs in the phosphate nodules, and, like the other minerals, are the result of the alteration of the variscite. Wardite appears to be one of the later minerals and is relatively common, far more so than the gordonite. It occurs in crusts of varying thickness, with well-developed crystals in the open vugs. Most of the crystals are not suitable for goniometric measurement, however, for many are deeply corroded and some are coated with a thin blue coating of a mineral resembling millisite. The crystals seldom exceed .5 mm. in size and are pale blue in color. They form tetragonal bipyramids and are, perhaps, the most easily recognizable of all the crystals of the nodules. The wardite crystals are usually in the center of a vug, surrounded by the yellow pseudowavellite, and often attached to it. Lehiite and millisite are later and coat the crystals or fill in the remainder of the cavity in some specimens.

Goniometric measurement of the crystals gave disappointing results; for despite their apparent perfection, the angles were unsatisfactory on many of the crystals, and the good ones give most surprising results. The dominant bipyramid gave especially inconsistent readings; some of which were to be expected from the striated nature of the face, but not all of which can be explained in that fashion. Many crystals were

measured; of these, fifteen were selected as being the most perfect with the best signals, and the elements calculated from these averages.

As may be seen from the measured angles in table I, the variation in the readings on the dominant second order bipyramid extend over a wide range, resulting in considerable uncertainty about the exact symbolization of that form. The average of 37 readings was used to obtain a ρ angle of $54^\circ 55'$, and it cannot be far off. This form may not, however, be taken as the unit, for then the narrower but much more consistent form which is to be called (201) would receive a much more complex symbol; even less likely than the (13·0·12) given the dominant form. If the angles of this form were reasonably consistent, this course might not

TABLE I.—Wardite: Two-circle measurements on fifteen crystals

FORMS	No. OF FACES	MEASURED RANGE						MEASURED MEAN			
		ϕ			ρ			ϕ		ρ	
c 001	15	—°	—'	—°	—'	—°	—'	—°	—'	—°	—'
a 100	14	—	—	—	—	—	—	—	—	—	—
t 13·0·12	37	—			53	29–57	38	—	—	54	55
. 907	4	—			58	11–59	55	—	—	59	27
u 201	29	—			68	11–69	57	—	—	69	08
. 301	1	—						—	—	74	56
. 447	2	—			46	40–47	31	—	—	47	05
. 134	4	16	43–18	20	40	22–49	30	17	44	45	27
. 4·9·12	21	20	53–26	44	44	04–51	52	23	47	47	20
. 6·10·15	12	27	51–32	41	44	11–49	53	29	48	46	29

be justifiable, but inasmuch as they are so variable the other alternative seems preferable. Furthermore, there is adequate corroboration in Lacroix (1910), in the description of the crystals of soumansite. His crystals were poor, but his form $b^{1/2}$ has a ρ angle of $42^\circ 40'$, which corresponds very favorably with the ρ angle of $42^\circ 51'$ which the form (112) would have if it were present on the crystals from Utah. There can be little question that the unit has been properly selected.

Table II is the angle-table for the mineral. All of the forms except b (112) were observed in the present study; this form is from Lacroix as discussed above. In addition to the certain forms, to which letters have been assigned, there are several others listed below which must be

called uncertain and requiring confirmation. Some of these were observed frequently, as may be seen in table I, but their observed angles were too inconsistent to warrant their acceptance. The symbols are relatively simple and the averages not far off from the calculated angles. (4·9·12) and (6·10·15) were often seen as thin truncations lying between the faces of the dominant bipyramid. Although they look like good forms on the crystals, the measurements are bad, with the signal often falling in a train-of-reflection running from one face to the next. One form (301) was seen but once, and while reasonably good in its measured angle it was not confirmed and cannot be accepted as certain.

TABLE II.—Wardite ($2\text{Na}_2\text{O} \cdot \text{CaO} \cdot 6\text{Al}_2\text{O}_3 \cdot 4\text{P}_2\text{O}_5 \cdot 17\text{H}_2\text{O}$)
ANGLE-TABLE

Tetragonal-ditetragonal bipyramidal class					
$p_0 = 1.3117$		$a:c = 1:1.3117$			
FORM	SYMBOL	ϕ		ρ	
c	001	—	° —'	—	° —'
a	100	00	00	90	00
t	13 0 12	00	00	54	52
u	201	00	00	69	08
b	112	45	00	42	51
FORMS REQUIRING CONFIRMATION					
.	907	00	00	59	20
.	301	00	00	75	45
.	447	45	00	46	40
.	134	18	26	46	08
.	4 9 12	23	58	47	07
.	6 10.15	30	58	45	33

The usual habit of the crystals is shown in Figs. 1 and 2. On most of the crystals, especially the smaller ones, the combination of forms is simple with only the base and the dominant bipyramid present. In some, however, usually the larger ones, the additional forms of Fig. 2 are present; (13·0·12) still dominant, but truncated by a narrower (201) and a still narrower prism. The edges between the faces of (13·0·12) are in most cases truncated by some of the uncertain forms. As these forms are so uneven and variable, it is probable that they developed through corrosion.

c (001) is usually present as a small, very brilliant face and is excel-

lent for orientation purposes. t (13-0-12) is large, but commonly striated parallel to its intersection with the base and u (201), and rarely gives a sharp signal. u is narrower and duller than t , but is usually not regularly striated and gives a sharp signal. a (100) is narrow and rarely gives a good signal, but is easily recognized from the zonal relations when it occurs.

The corrosion of the wardite crystals is interesting. On one specimen the pyramidal forms were corroded so deeply that the crystals resembled simply terminated tetragonal prisms. The crystals were exceedingly minute and the surfaces developed appeared to be rounded, without any evidence of actual prism planes. Through this attack, the base survived as a brilliant, unetched form, showing no signs of the

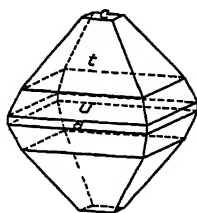
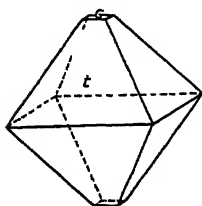
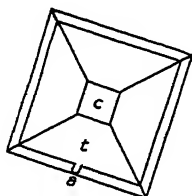
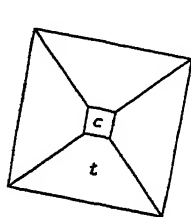


Fig. 1

Fig. 2

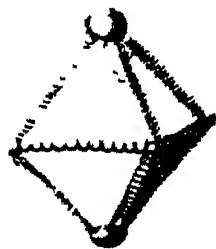


Fig. 3

solution which had almost destroyed the rest of the crystal. A more common etching only rounded the edges, with less complete destruction of the whole. The base seems always to survive and has remained brilliant on all the crystals studied.

An interesting example of selective incrustation was observed on some of the crystals with the coatings of millisite. Small spheres of the later mineral were often observed attached to the bases of the wardite crystals. A further stage in this growth has resulted, in some specimens, in the formation of millisite shelves along the edges of the bipyramids, overlapping each other up the crystal like fungi growing up a dead log. Fig. 3 represents such a selectively coated wardite crystal. Finally, the whole crystal may be coated over, usually with a thickening of the

incrustation at the edges between the pyramid faces. Beneath the millisite, the original faces are corroded and dull.

The study has shown the morphological similarity of wardite and soumansite. The new c is about double that of Lacroix; 1.3117 as compared to 0.7672, but gives more satisfactory indices. The crystals are remarkable in being dominated by a form with a symbol as complex as (13·0·12), but the measurements permit no other choice. A new locality may yield crystals which will permit confirmation of some of the uncertain forms, but it is not likely that they can be checked by additional measurements of Fairfield, Utah crystals, unless far better ones are found than are now available.

REFERENCES

- LACROIX, A. 1910. *Mineralogie de La France*, IV, pp. 541-542.
LARSEN, E. S. AND SHANNON, E. V. 1930. *Amer. Min.*, XV, pp. 307-337.
POUGH, F. H. 1937. *Amer. Min.*, XXII, pp. 625-629.

AMERICAN MUSEUM NOVITATES

Number 933

Published by
THE AMERICAN MUSEUM OF NATURAL HISTORY
New York City

July 6, 1937

BIRDS COLLECTED DURING THE WHITNEY SOUTH SEA EXPEDITION. XXXIV¹

THE DISTRIBUTION AND THE MIGRATION OF THE LONG-TAILED CUCKOO (*URODYNAMIS TAITENSIS* SPARRMAN)

BY CARDINE BOGERT

A great many papers are published every year on the migrations of the birds of the Northern Hemisphere. Little, however, is known of the extensive wanderings of the southern birds, although they are in many ways even more fascinating. The wonderful material of the wandering New Zealand cuckoo, *Urodynamis taitensis*, in the collection of The American Museum of Natural History makes it possible to draw a picture of the migration of this species which complements in many respects the scattered information published in the past. A short description of the species and an historical review will be given before I enter the detailed discussion of the migrations. I much appreciate the kind assistance Dr. Ernst Mayr has given me during the preparation of this report. Mr. J. Sterling Rockefeller gave me his kind permission to use extensive notes that he also had collected on this species. Messrs. Berlioz, Friedmann, Junge, Kinnear, Peters, de Schauensee, Stresemann and Yamashina kindly sent me full information on specimens of the collections of which they are in charge.

*Urodynamis taitensis*² (Sparrman)

Cuculus taitensis SPARRMAN, 1787, 'Museum Carlson.,' fasc. II, No. 32.—Tahiti, Society Islands.

Cuculus tahiticus GMELIN, 1788, 'Syst. Nat.,' I, pt. 1, p. 412.—Tahiti.

Cuculus perlatus VIEILLOT, 1817, 'Nouv. Dict. d'Hist. Nat.,' nouv. ed., VIII, p. 232.—Tahiti, Society Islands.

Cuculus fasciatus FORSTER, 1844, 'Descr. Anim.,' p. 160.—Tahiti.

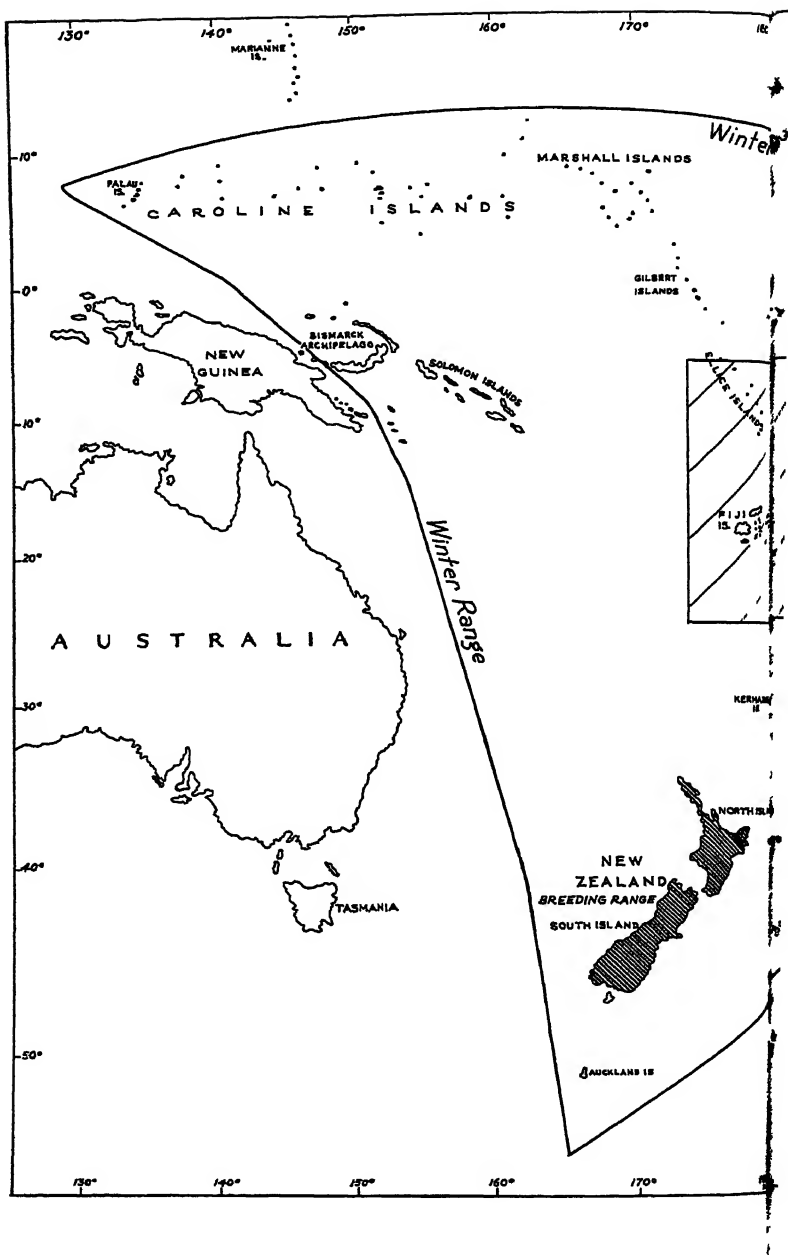
Eudynamis cuneicauda PEALE, 1848, 'U. S. Explor. Exped.,' Birds, p. 139.—Ovalau, Fiji Island.

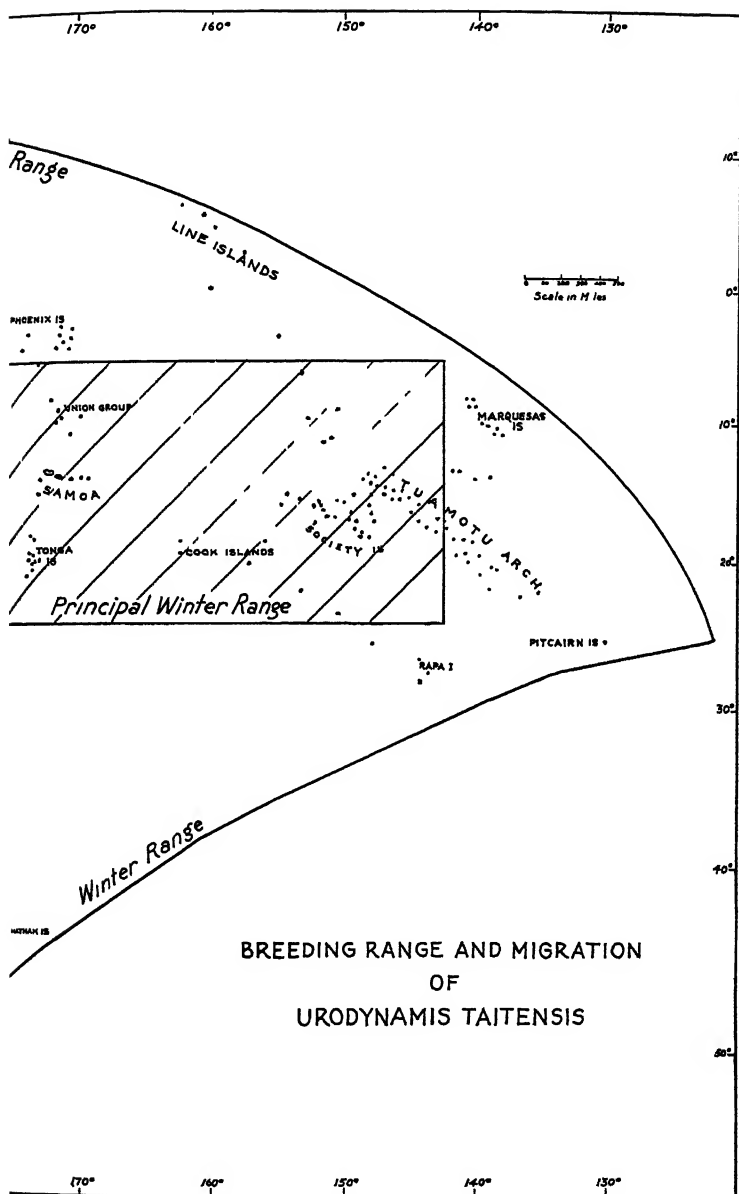
Urodynamis taitensis philetus WETMORE, 1917, Proc. Biol. Soc. Wash., XXX, p. 1.—Otago Prov., New Zealand.

Urodynamis taitensis belli MATHEWS, 1918, Bull. Brit. Orn. Club, XXIX, p. 24.—Norfolk Is.

¹ Previous papers in this series comprise American Museum Novitates Nos. 115, 124, 149, 322, 337, 350, 356, 364, 365, 370, 419, 469, 486, 488, 489, 502, 504, 516, 520, 522, 531, 590, 609, 628, 651, 665, 666, 709, 714, 820, 828, 912 and 915.

² Also often quoted as *taitiensis* or *tahitiensis*, although the original spelling is *taitenis*.





ADULT MALE.—General coloration above dark brown, with rufous bars and spots, below white, with dark brown stripes. Crown and nape blackish brown with narrow rufous shaft-streaks; back, scapulars and rump blackish brown, each feather with broad rufous bars and paler, sometimes whitish tips; upper wing-coverts similar to feathers of the back, but with the white tips more pronounced; wing-feathers dark brown with whitish rufous cross bars, each bar being more rufous near the shaft and white or whitish near the edge of the inner and outer web; under wing-coverts and axillaries deep or pale buff; tail-feathers with rufous and blackish bars of about equal width and whitish tips; supraloral spot and superciliary stripe whitish; ear-coverts dark brown with light streaks; under parts very variable whitish, buff or pale rufous, with few or numerous longitudinal stripes, which are most pronounced on breast and flanks; under tail-coverts whitish with blackish bars.

ADULT FEMALE.—Very similar to male, but slightly smaller, averages above duller and darker, particularly in the rufous markings; white tips of the scapulars more pronounced; rufous wash of throat and rest of under parts more pronounced. There is considerable individual variation and some individuals cannot be separated from males.

IMMATURE.—Entire upper parts spotted with white, bars on tail whitish or buff, not deep rufous.

Wing: ♂ ad. 186–192 (189.9); ♀ ad. 175–185 (181.4).

Tail: ♂ ad. 221–236; ♀ ad. 196–230.

The great amount of individual variability and the uncertainty about the breeding range has misled several authors to redescribe this species. As late as 1917, Wetmore separated the New Zealand birds as a distinct subspecies from the Polynesian birds, not realizing that the latter were only migrants from New Zealand. His material consisted apparently of 3 or 4 New Zealand birds and 2 from Polynesia, and the characters he gives are all within the range of individual variation of either New Zealand or Polynesian birds. There is no definite evidence that the species reproduces on Norfolk Island and Mathews' statement that Norfolk Island birds were "lighter above" is not true.

RANGE.—The species breeds, as far as we know, only on New Zealand. On its migration and during the winter, it is found accidentally on Chatham and Kermadec Is., Auckland Is., and regularly in Melanesia, Micronesia, as far west as Palau, and Polynesia, as far east as the Marquesas Is.

HISTORY OF DISCOVERY

Dr. Sparrman and J. R. Forster, who accompanied Capt. Cook during his second voyage, first discovered *Urodynamis taitensis* at Tahiti in August, 1773. In February, 1777, when Cook touched Queen Charlotte's Sound, N. Z., on his last voyage, we find mention of this species once again, the first report of this species at New Zealand. In

1779, Buffon (IV, p. 376) refers to "Le Couou brun varié de Noir," and states its habitat as: "Islands of the Pacific, Tahiti, New Zealand, Tonga-taboo," obviously basing his notes on information received from the naturalists of Cook's voyages. For more than sixty years no new information was obtained on the occurrence of *Urodynamis* in Polynesia. The species is frequently mentioned in the ornithological publications of that period, but all these notes refer to the above-mentioned observations. A complete list of references can be found in Wigglesworth, 1891, 'Aves Polynesiæ,' p. 11.

In the forties of the last century the species was found in Polynesia by several of the large expeditions (Peale, etc.), and after the middle of the century the number of the recorded specimens increased very rapidly, particularly owing to the activities of the collectors of the Museum Godeffroy. During all that time it was supposed that the species was a resident of Polynesia, except by the New Zealand ornithologists who had at that time already found out that it left its breeding range during the winter.

"It is migratory, says Dr. Dieffenbach in 1843, and appears on the coast of New Zealand in the month of December." (Buller, 1873, B. N. Z., p. 73.)

The migratory habits of this species, the sudden disappearance in New Zealand, and the lack of any breeding activities in its winter range baffled both natives and naturalists, and has resulted in some very curious beliefs which seem worth recording.

Rev. Wm. Yates in 1835, when in New Zealand, writes, that according to the natives, "this bird secures itself during the winter months in the holes of the puriri-trees. . . ."

Rev. Taylor in his book, 'Te Ikaa Mani,' reports: "The Long-tailed Cuckoo in the autumn buries itself in the mud of river beds and there hibernates till the following spring."

The belief that the species was a resident of Polynesia was so firmly rooted that several times supposed eggs of the species were collected in its winter range, and that even detailed descriptions of its breeding habits were given. It was Finsch (1880, Ibis, p. 433) who first expressed his doubts: "I observed twice *Eudynamis taitensis* on Butaritari, Dec. 7, 1879. . . . Except the cuckoo which apparently is only a migratory bird, there is no other land bird on the Gilberts."

Since no other land birds were known to exist on the Gilbert Islands, Mr. Swayne of Sydney presumes that it laid its eggs in the nest of the noddy tern (*Anous stolidus*). In fact, he writes that "he had seen this

cuckoo oust a noddy tern from its nest and take possession of it." (Proc. Zool. Soc., 1896, p. 934.) How he could believe that the young cuckoo could survive on the same diet as that of a young tern is rather astonishing.

Wetmore was deceived by such reports into considering the Polynesian birds an endemic resident subspecies (1917, Proc. Biol. Soc. Washington, XXX, p. 1).

LIFE HISTORY

From observations made in the last twenty years, it is now certain that *Urodynamis taitensis* reproduces exclusively on New Zealand and occurs in Micronesia, Melanesia and Polynesia only as a winter visitor. By the first of November most of the long-tailed cuckoos have returned to New Zealand and have started mating. In November and December, the bird is laying, and the young cuckoos appear in January and February (condensed from Fulton, 1903, Trans. New Zealand Inst., XXXVI pp. 113-145). In March they gather in small groups and set off on their (fall) migration to the tropical islands.

The long-tailed cuckoo of New Zealand belongs to the parasitic cuckoos. According to the observations of many ornithologists the reputed foster parents of this bird are¹:

Turnagra capensis,² *Hemiphaga novaeseelandiae*, *Gerygone flaviventris*, *Pseudogerygone igata*, *Petroica macrocephala*,² *Miro australis*,² *Petroica toitoi*, *Rhipidura flabellifera*, *Mohoua ochrocephala*,² *Mohoua albigilla*,² *Zosterops lateralis*, *Finschia novaeseelandiae*, *Prothemadera novaeseelandiae*, *Anthornis melanura*,² *Chloris chloris*.²

In spite of the intensive ornithological work carried on in New Zealand during the past 100 years, the eggs of this species remained unknown until last year. Erroneous descriptions, including that of a dwarf pullet's egg (!), have been given by many authors (Ramsay, 1865, Ibis, p. 155; Nehr Korn, 1879, Journ. f. Ornith., p. 394; Buller, 1888, 'Birds of New Zealand,' 2nd Ed., I, p. 127; Fulton, 1903, Trans. New Zealand Inst., p. 141; Oliver, 1930, 'New Zealand Birds,' p. 426), but Stead is the first author to describe an egg of a size which would seem probable for such a small bird as *Urodynamis*. His description is as follows: "Ground colour white, tinted with cream, or creamy pink, freely spotted and streaked with purplish brown, and having under-

¹ E. F. Stead, 1936, Trans. and Proc. Roy. Soc. of New Zealand, LVI, part 2, pp. 182-184; on 1903 Trans. New Zealand Inst. XXXVI, p. 141; Oliver, New Zealand Birds, pp. 447-506.

sive.

² feeding young

lying spots of gray, the markings being larger and more numerous at the larger end of the egg. The shape is ovoid-elliptical, and the measurements in mm. of four specimens are: (in mm.) 23.5×17 ; 23×17.75 ; 22.75×17.5 ; 22.5×18 ." (Stead, Sept. 1936, Trans. Proc. Roy. Soc. New Zealand, LXVI, pp. 182-184.)

TIME OF MIGRATION

Enough observations have been collected on New Zealand during the last century to enable me to draw a fairly correct picture of the migratory habit of this species. Its movements are somewhat obscured by the fact that the migratory urge is not equally strong in all individuals. Not all of them fly to the tropical winter quarters, but some remain in New Zealand throughout the winter and still others appear as stragglers on the outlying islands of the New Zealand region (Auckland Is., Chatham Is. and Kermadec Is.) or in different parts of New Zealand, itself. Many such cases have been reported by Fulton (*loc. cit.*) and elsewhere in the New Zealand literature.

The outline of the main migration is approximately as follows: This species arrives at New Zealand during October and through November. According to observers, *Urodynamis taiitensis* arrives in groups, and a few solitarily, usually at night from the northeast (Fulton, *loc. cit.*). At first there are many more males than females. For a while they are rather quiet; in November, however, they become active.

The fall migration starts from New Zealand during February and throughout March. They begin to disappear, some gradually moving to North Island from where they leave, others probably leaving direct from the South Island, the young remaining till last (Fulton, *loc. cit.*). They have been seen in New Zealand assembling in groups up to about a dozen for migration at this time.

MIGRATION ROUTE AND WINTER RANGE

No attempt has been made to collect the exceedingly scattered literature on this subject, since Finsch published his account (1901, Notes Leyden Mus., XXII, pp. 120-125). Since then a number of additional records have been published, but what is more important, the Whitney South Sea Expedition had been in the field in the years 1921-1933 and has collected a superb series of this species from a wide range of localities. Information on unpublished material of other museums has also been available owing to the courtesy of the curators of these institutions. All in all, I have gathered information on about 200 specimens from

the range of the species outside of New Zealand, 130 of which are in the collections of The American Museum of Natural History (including the Rothschild Collection).

This extensive material permits a much more detailed description of the migration route and the winter quarters than has hitherto been possible. The latest authority on New Zealand birds (Oliver, *loc. cit.*, p. 426) writes: "Passes presumably through Norfolk Island and the Kermadecs on migration and winters in the islands of the Western Pacific." Information in other books is equally sketchy. It seems important to list in detail the complete records of this species collected by me.

A.—NEW ZEALAND REGION

(1) KERMADEC ISLANDS:—2 ♂, 1 ♀, Sunday I., May 15, June 11, Aug. 23, 1913, by Bell (Rothschild Collection).—2 specimens, by Dannefaerd (Rothschild Collection).—1 specimen, Sunday I., 1894, by Travers (Rothschild Collection).—1 specimen presented to Buller (1891, *Trans. N. Z. Inst.*, p. 28).—1 specimen (Cheeseman, 1890, *Trans. N. Z. Inst.*, p. 219).—A few remain all year, plentiful in March (Oliver, 1935, *N. Z. Birds*).—Numerous in October, heard every month in 1908 (Iredale, 1913, *Trans. N. Z. Inst.*, pp. 78–92).

(2) NORFOLK ISLAND:—1 ♂, Nov. 2, 1912, by Bell (type of *U. i. belli* Mathews) (Rothschild Collection).—3 ♂, 1 ♀, Steels Pt., Oct. 30, Nov. 4, 1912, by Bell (Rothschild Collection).—1 ♂, Furney Lane, March 9, 1913, by Bell (Rothschild Collection).—1 ♂, Mt. Pitt, March 17, 1913, by Bell (Rothschild Collection).—1 specimen, by Metcalf Crowfoot (1885, *Ibis*, p. 270) (*Mus. Comp. Zool. Cambridge*).—3 specimens (Ramsay, 1888, *Tab. List*, p. 37).—Specimens (Hull, 1910, *Ioc. Linn. Soc. New So. Wales*, p. 34).

(3) LORD HOWE ISLAND:—1 specimen shot (Hull, 1910, *Proc. Linn. Soc. New South Wales*, p. 34).—Spent winter (Fulton, 1903, *Trans. N. Z. Inst.*, XXXVI, pp. 113–148).

(4) CHATHAM ISLAND:—Seen throughout winter (Fulton, *loc. cit.*).

(5) AUCKLAND ISLAND:—Seen throughout winter (Fulton, *loc. cit.*).

B.—SOUTHERN MELANESIA

(1) NEW CALEDONIA:—1 ♀ imm., Nouméa, April 8, 1875, by Germain (*Mus. d'Hist. Nat.*, Paris).—1 ♂, June 17, 1881 (in Tristram Collection).—Specimens from streets of Nouméa, 2 showing nesting plumage, March 23, 1879, March 15, 2 on April 15, 1881 (Marie, 1877, *Ibis*, p. 362; Layard, 1882, *Ibis*, pp. 523, 543) (*Brit. Mus.*).

(2) NEW HEBRIDES:—1 ♂, Ambrym, Aug. 14, 1926 (Whitney S. S. Exp.).—1 ♀, Aniwa, March 24, 1936 (L. Macmillan).—1 specimen, Efate (Vate) Is., June 12, 1877, shot by native (Layard, 1878, *Ibis*, p. 27) (*Brit. Mus.*).—Ambrym, feathers worn by native (Layard, 1878, *Ibis*, p. 27).

(3) SANTA CRUZ:—1 ♀, Tinakula, March 2, 1927.—1 ♂, Lomlom I., Reef Is., Oct. 9, 1926.—1 ♀, Nepani, Swallow I., Oct. 15, 1926.—1 ♂, Fenualoa, Reef Is., Oct. 11, 1926 (all Whitney S. S. Exp.).

C.—NORTHERN MELANESIA

(1) SOLOMON ISLANDS:—1 ♂, Ramos I., Sept. 5, 1927.—1 ♀, Tiara, Aug. 25, 1927.—1 ♀, Malaika I. (3000 ft.), April 15, 1930.—1 ♀, Gower I., April 5, 1930, 1 ♂, Sept. 21, 1930.—1 ♂, Ontong Java, Oct. 4, 1930.—1 ♂, Nissan, Aug. 10, 1929.—1 ♀, Oema I., May 11, 1928 (all Whitney S. S. Exp.).—2 ♂, Aola, Guadalcanar, April 20, by Woodford, May 20, 1887 (Grant, 1888, Proc. Zool. Soc. London, p. 191), 1 ♂ imm., Guadalcanar, April 17, 1901, by Meek.—1 ♀, Rendova, Feb. 20, 1904, by Meek (Nov. Zool., XII, p. 258).—3 ♀, Nissan I., Sept. 2, 12, 15, 1924, by Eichhorn (all Rothschild Collection).—3 specimens, Savo (Ramsay, 1879, Proc. Linn. Soc. New South Wales, IV, p. 20; 1882, Ibis, p. 143).

(2) BISMARCK ARCHIPELAGO:—1 ♂, Duke of York Is., July 19, 1879, by Kleinschmidt (Layard, 1880, Ibis, p. 300) (Brit. Mus.).—1 ♀, April, 1878, by Brown (Tristram Collection).—1 imm., Vuatom, May 11, 1933, by O. Meyer (Orn. Monatsber., XLI, p. 153) (Berlin Mus.).—1 specimen, Blanche Bay, New Britain (Finsch, 1881, Ibis, p. 537).

(3) NEW GUINEA REGION:—1 ♂(?), St. Aignan, Louisiade Arch., Sept. 10, 1897 (Rothschild Collection).

D.—MICRONESIA

(1) PALAU:—1 specimen (Finsch, 1875, Journ. Mus. Godef., VIII, p. 49).

(2) CAROLINE ISLANDS:—1 ♂, Ruk I., July 1, 1896, by Owston (Rothschild Collection).—2 ♂, 1 ♀, Kusaie, March 15, April 5, April 15, 1931 (Whitney S. S. Exp.).—1 ♂, Ponape, Aug. 15, 1934, by Ikkaku (Yamashina Collection, Tokyo).—2 ♂, Truk, May 9, 25, 1931, by H. Orii (Yamashina Collection, Tokyo).—1(?), Ponape, March 2-17, 1880, by Kubary (Finsch, 1881, Ibis, p. 113).—1 ♀, Ponape, Sept. 1873, by Kubary (possibly repetition) (Proc. Zool. Soc. London, 1877, p. 778; id., 1900, Notes Leyden Mus., p. 120; id., 1876, Journ. Mus. Godef., V, Heft 12, p. 19).

(3) MARSHALL ISLANDS:—1 ♂, Iringlove, Oct. 24, 1931, by H. Orii.—1 ♂, Wozzie, Sept. 23, 1931, by H. Orii.—1 ♀, Auru, Sept. 25, 1931, by H. Orii.—2 ♀, Jaluit, Jan. 3, 6, 1933, by Kawakami (all Yamashina Collection, Tokyo).—1 ♀, with breeding patch (1893, Ibis, pp. 210-215).—1 specimen, Ratak, Eastern Chain, Oct. 21, 1879, brought in by a native (Finsch, 1880, Ibis, p. 300; id., 1900, Notes Leyden Mus., p. 123).—Seen twice, Jaluit, Aug. 5, 21, 1879, by Finsch (1880, Ibis, p. 220).

(4) GILBERT ISLANDS:—Seen twice, Butaritari, Dec. 7, 1879, by Finsch (1880, Ibis, p. 433).—1 specimen seen from Makin I., Butaritari, 1895 (North, 1896, Proc. Zool. Soc. London, p. 300).

E.—CENTRAL POLYNESIA

(1) FIJI ISLANDS:—1 ♂, Nanuku Levu I., Nov. 26, 1924.—1 ♀, Vanua Vatu I., Sept. 13, 1924.—2 ♂, Turtle I., June 17, 1925.—1 ♀, Nakuemanu, Nov. 27, 1924 (all Whitney S. S. Exp.).—1 specimen, Taviuni (Layard, 1876, Ibis, p. 144).—Levuka Ovalau, Mokani, Wakaia (Layard, 1876, Ibis, p. 391).—1 ♀, Wakaia, Sept. 12, 1875, by Layard (Brit. Mus.).—1 imm., Taviuni, Aug. 20, 1923, by C. A. Wood (1925, Ibis, p. 835) (U. S. Nat. Mus.).—1 specimen, Ovalau, May, by Peale, (Cassin, 1885, Expl. Exp.) (type of *Eudynamis cuneicauda* Peale) (U. S. Nat. Mus.).

(2) TONGA ISLANDS:—1 ♂, 1 ♀, Fanua Lai Is., Aug. 15, 1925.—1 ♀, Nomuka I., July 22, 1925.—1 ♂, Ata I., July 14, 1925.—1 ♂, Vavau, Aug. 11, 1925 (all Whit-

ney S. S. Exp.).—2 ♀, Tongatabu, April 10, May 11, 1889, by Lister (Brit. Mus.).—1 specimen, Eua, May 29, 1889, by Lister (Brit. Mus.).—1 ♂ imm., Eua, Aug., 1876, by Hubner (Finsch, 1877, Proc. Zool. Soc. London, p. 773).—1 specimen, Tongatabu Gray, 1859, B. of Trop. Is., p. 35) (Brit. Mus.).

(3) SMALL ISLANDS OF CENTRAL POLYNESIA (Niue, Niuafo, Wallis, Fotuna Is.):—3 ♂, 3 ♀, Wallis Is., April 27, 29, 30, 1925.—1 ♀, 1 ♂, Fotuna I., May 7, 1925, July 30, 1925.—1 ♂, Alofa I., May 12, 1925.—1 ♂, 1 ♀, Danger Is., March 1, 1924.—1 ♂, Niuafo Is., Aug. 17, 1925 (all Whitney S. S. Exp.).—1 specimen, Niue I., by Earl of Ranfurly (Brit. Mus.).—1 specimen, Niuafo I., Oct. by Hubner.

(4) SAMOA ISLANDS:—1 ♂, Tutuila, Nov. 28, 1923.—1 specimen, Amer. Samoa (data lost).—1 ♀, Tau Manua, Dec. 21, 1923.—1 ♀, Ofu Manua, Jan. 10, 1924.—2 ♀, Anuu I., Jan. 11, 1924.—1 ♀, Olosenga, Manua Is., Jan. 4, 1924 (all Whitney S. S. Exp.).—1 ♂, 2(?), Upolu, by Krause (Rothschild Collection ex Mus. Godefroy).—1 ♀, Upolu, Mar. 6, 1895, by Woodford (Rothschild Collection).—1 specimen, 1895, by Woodford (Rothschild Collection).—1 specimen, 1911, Mitchell (Rothschild Collection).—1 ♂, 1 ♀, by Whitmee (Layard Collection, Brit. Mus.).—1 specimen, Tutuila, June 9, 1889, by Lister (Brit. Mus.).—1 adult, Aug., 1886, by Krause (Finsch, 1900, Notes Leyden Mus., XXII, p. 120) (Leyden Mus.).—Less abundant, never seen alive (Whitmee, 1875, Ibis, p. 437).—1 imm. (Whitmee, Cat. Brit. Birds, XIX, p. 315) (Brit. Mus.).—1 specimen (Layard, Dec., 1876, Proc. Zool. Soc. London, p. 491).—1 ♂ ad., Upolu, May, 1898, by Thilenius (Berlin Mus.).

(5) UNION, ELLICE, PHOENIX ISLANDS:—3 ♂, 1 ♀ (?), Fakafo I., Union group, April 2, 3, 4, 1924 (Whitney S. S. Exp.).—1(?), Funafuti, Ellice Is., Dec., 24, 1899, by Townsend (1919, Bull. Mus. Comp. Zool., LXIII, pp. 151-225).—1 specimen, Ellice Is. (Hull, 1910, Proc. Linn. Soc. New So. Wales, p. 34).

F.—EASTERN POLYNESIA

(1) COOK ISLANDS:—1 specimen, Raratonga, July, 1895 (Rothschild Collection).—1 ♂, 1 ♀, Raratonga, Feb. 14, 20, 1903, by Seale (A.M.N.H.).—1 specimen, Palmerston I., April 16, 1779 (Cook).—1 specimen, Raratonga (1905, Ibis, p. 600; 1859, Gray, B. of Trop. Is., p. 35; Finsch and Hartlaub, 1879, Orn. Cent. Poly., p. 27; id., 1870, Journ. f. Ornith., p. 122).

(2) SOCIETY ISLANDS:—6 ♂, 1 ♀, Moorea, June 23, July 7, 15, 20, Oct. 31, 1921.—1(?), Mehetia (Maitea), Jan. 29, 1923.—3 ♂, 4 ♀, Tahiti, March 15, May 31, Aug. 13, Sept. 2, Nov. 23, 1921, Jan. 8, 12, 1923 (all Whitney S. S. Exp.).—2 specimens, Tahiti, 1850, by Ribourt (Mus. d'Hist. Nat., Paris).—2 specimens, Tahiti, 1843, by "La Danaide" (Mus. d'Hist. Nat., Paris).—1 specimen, Tahiti, 1847, by Arnou (Mus. d'Hist. Nat., Paris).—1 specimen, Tahiti (Rothschild Collection).

(3) AUSTRAL ISLANDS:—2 ♂, 1 ♀, Rimitara, March 24, 25, 1921.—4 ♂, 1 ♀, Tubuai, April 5, 6, May 3, 1921.—5 ♂, Ravavai, April 25, 26, 1921.—1 ♂, 1 ♀, 1(?), Vavita, April 25, 1920.—1 ♂, 1 (?), Rapa Is., April 16, 18, 1921 (all Whitney S. S. Exp.).—At Pitcairn I., acc. to natives (Hull, 1910, Proc. Linn. Soc. New So. Wales, XXXIV, p. 34).

(4) TUAMOTU ARCHIPELAGO:—1 ♂, Mangareva, May 8, 1922.—1 ♀, Maria, May 31, 1922.—1 (?), Tenarunga, June 14, 1922.—1 ♂, Makatea, Aug. 21, 1922.—1 ♀, Takapotu, Aug. 29, 1922.—1 ♂, Hiti, May 4, 1923.—1 ♀, Takume, May 11, 1923.—1 ♂, Makemo, May 21, 1923.—2 ♂, Katiu, May 25, 1923.—1 ♂, Taiaro,

May 28, 1923.—1 ♂, June 4, 1923.—1 ♀, Apataki, June 9, 1923.—1 ♂, Takahau, June 21, 1923 (all Whitney S. S. Exp.).

(5) MARQUESAS ISLANDS:—2 specimens, Nukuhiva, 1848, by M. Mercier (Mus. d'Hist. Nat., Paris).—Mentioned (Finsch and Hartlaub, 1867, Orn. Cent. Poly., 27; id., 1870, Journ. f. Ornith., p. 122).—Mentioned (Fulton, 1903, Trans. N. Z. Inst., XXXVI, pp. 115-148; Gray, 1859, B. of Trop. Is.).

From the specimens that I have examined, only one out of 37 from Melanesia was found during its breeding season (Feb.). From Micronesia, only 2 specimens out of 9 were found during the breeding season (Dec.). From Polynesia, 3 were collected in Dec., 5 in Jan., 2 in Feb.—which is a small percentage of the 134 specimens found there.

Therefore it seems evident that the majority migrates to Polynesia, some others as far as Melanesia, Micronesia and the stragglers winter in the islands of the New Zealand region. The number of specimens collected in Polynesia are found to be about equally divided numerically between Central and Eastern Polynesia. Those remaining throughout the breeding season in their winter quarters are usually immature birds. No specimen has yet been found in Australia, New Guinea or farther west.

HISTORY OF MIGRATION

It is not known when *Urodynamis taitenis* originally came to New Zealand or Polynesia. It is undoubtedly closely related to *Eudynamis scolopacea* which occurs eastward as far as Australia, the Papuan region and Northern Melanesia.

Most subtropical and temperate-zone cuckoos of the Southern Hemisphere are migratory. They live mostly on caterpillars which are not available in their breeding area during winter. This may be the reason why they migrate, but it is much more difficult to explain the origin of the extensive migrations of these island birds than the origin of the small movements of continental birds. At the present time the migrations of this species seem to extend much beyond the necessary distance. With plenty of food available at the Fiji, Tonga and Samoa Islands, there seems to be no reason why some birds embark on the perilous journey to such isolated, outlying islands, as Palau, Reef, the Marshall Islands and the Marquesas. Individuals that venture past these islands would unquestionably perish in the endless ocean that stretches beyond. Birds that winter on these outlying islands travel more than 8000 miles between breeding seasons, most of it over open water. Here is another fertile field for the student of the problem of "homing."

The migration of *Urodynamis tartensis* is quite similar to that of the other New Zealand cuckoo, *Chalcites lucidus*. The bronzed cuckoo, however, goes only as far as the Solomon Islands and the Bismarck Archipelago (see Mayr, 1932, Amer. Mus. Novit., No. 520, pp. 3-5).

AMERICAN MUSEUM NOVITATES

Number 934

Published by
THE AMERICAN MUSEUM OF NATURAL HISTORY
New York City

July 7, 1937

SYNGNATHUS WALCOTTI, A NEW WEST INDIAN PIPEFISH

By J. T. NICHOLS

We have recently received an interesting pipefish collected in the Virgin Islands by Dr. Alfred R. Whitney, a Life Member of the Museum, which we have been unable to place with any of the numerous species described in the literature, and take pleasure in naming it for Walcott Younger, whose interest in fishes led him to bring the specimen to us from Dr. Whitney.

Syngnathus walcotti, new species

DESCRIPTION OF TYPE.—No. 13685, American Museum of Natural History, from the island of St. John, Virgin Islands, collected January 27, 1937, by Alfred R. Whitney.

Nape broad, elevated, keeled, and snout which is of moderate length and unusually slender, slanting appreciably downward from the line of the body.

Length to base of caudal 143 mm. Head in this length, 7.5; trunk 3.2 1/2; tail, 1.8. Snout in head, 1.8; dorsal base, 1.7. Eye in snout, 4; width, and depth of body, 2; width of nape, 2.7; caudal fin, 2.5. Pectoral base, and length of pectoral in eye, 1; anal, 1.4.

Dorsal rays, 23, on the first 5 caudal, and extending slightly onto the last body ring. Rings 17 + 32.

Ridges at the edges of upper and lower surfaces of the body sharp, the back and the 4 faces of the tail being concave; lateral ventral ridges continuous from throat to caudal, and a median ventral ridge back to next to the last body ring; lateral ridges of the back converge posteriorly and end on the ring before the end of the dorsal fin, they converge anteriorly at the neck, and diverge again to bound the broad rounded, elevated flattish nape, which has a low but well-marked median keel, ending on the first body ring; side with a low median ridge ending under the origin of the dorsal, and under the front end of the lateral dorsal ridge of tail, which here lies about half way between it and the lateral dorsal ridge of trunk; a very slight ridge on front of opercle not continued backward; orbital rim raised and interorbital concave.

Color pale, lightly marked with olive-brown.

Of recently recognized West Indian pipefishes this form most closely resembles *Syngnathus elucens* Poey, and through the courtesy of Mr. John Tee-Van, we have been able to compare specimens of *S. elucens* as recorded from Bermuda by Beebe and Tee-Van, with it. It has a notably longer, more slender snout and smaller mouth. It resembles *Syngnathus acus* Linnaeus (Weber and de Beaufort, 1922, Fishes Indo-Aust. Archip., IV, p. 89, Fig. 37) recognized from the Mediterranean to the East Indies, but has a notably shorter tail and dorsal fin.

AMERICAN MUSEUM NOVITATES

Number 935

Published by
THE AMERICAN MUSEUM OF NATURAL HISTORY
New York City

July 7, 1937

TRICHOPEPLA KLOTSI, A NEW SPECIES OF PENTATOMID FROM WYOMING (HETEROPTERA)

By HERBERT RUCKES

The pentatomid genus *Trichopepla* Stål has heretofore contained only two species, *T. semivittata* (Say) and *T. atricornis* Stål. The former has a distribution in the United States that includes an area from Colorado eastward to the Atlantic Coast; the latter is more northern and north-western, is found in our Great Lakes region, southern Canada, Washington, Montana, British America and Alaska. During the summer of 1935 the author in company with Dr. A. B. Klots visited the University of Wyoming Summer School in the Medicine Bow Range near Centennial, Wyoming. Collecting in the vicinity yielded few pentatomids; the best grounds found were a wet hillside about half a mile below the entrance to the school buildings, on the road to Centennial. Here was a lush vegetation, an ideal place for pentatomids. They were very uncommon, however; of the few taken, four belong to the genus *Trichopepla* and apparently these represent a new species. There are three females and one male in the series. All are smaller than the more common *T. semivittata* and *T. atricornis* and are likewise somewhat darker.

The following diagnostic key will help to distinguish the three species.

- 1.—Head distinctly tapering toward apex; tylus raised; gena narrow and sloping toward apex; antennae with only the distal two segments black; antennal segment 2 and 4 subequal; segment 3 about two-thirds length of 2, pronotum coarsely and irregularly punctate with punctures widespread; front half of pronotum somewhat declivent; basal half of scutellum coarsely and irregularly punctate; apical half finely and regularly so; shoulders of scutellum with well-defined calloused yellowish or ivory areas; ventral anterior angles of abdominal segments with a black patch, small but conspicuous; body pubescence strong and abundant. *semivittata* (Say).
Head more or less rounded or truncate, not tapering; only antennal segment one rufous; others black or very dark. 2.
- 2.—Apex of head rounded; tylus not raised and gena not sloping toward apex; antennal segment 2 slightly longer than segment 4; segment 3 about two-thirds the length of 2; pronotum with more regular punctures, these medium coarse; impunctate areas (calli) of pronotum evident but depressed; scutellum finely and uniformly punctate throughout; impunctate areas near shoulder of scutellum prominent; anterior ventral angles of abdominal segments without a

prominent patch but with a small cluster of fine rufous punctures; body pubescence weak and sparse. *atricornis* Stål.
 Apex of head almost truncate or at least squarely rounded; tylus slightly convex but not appreciably raised; gena broad with the lateral margins definitely sinuate in front of eyes; inner margins lightly arcuate; head distinctly declivent; antennal segments all stubby; segments 2, 3, and 4 subequal; segment 3 only slightly shorter than the others; pronotum with punctures fine but not very regular; calloused areas except lateral margins not conspicuous; calli not so evident; scutellum finely and evenly punctate throughout; impunctate areas at base of scutellum not well defined; osteolar canal somewhat raised, its pit black; anterior angles of ventral abdominal segments with two or three prominent black or rufous punctures; body pubescence strong but sparse; legs strongly pilose. *klotsi*, n. sp.

Trichopepla klotsi, new species

Smaller than either *T. semivittata* (Say) or *T. atricornis* Stål; maximum measurements: length, 6 mm.; width, 4.5 mm. Body ovate subdepressed; above reddish yellow marked with numerous fine fuscous to black punctures; irregular smooth areas not well defined; connexivum alternated with black and yellow; ventral anterior angles of abdominal segments with two or three black or fuscous punctures.

Head.—Broadly rounded, almost truncate at apex and strongly declivent; tylus slightly convex but not appreciably raised; gena broad with the lateral margins clearly sinuate in front of eyes; inner margins slightly arcuate; punctures fine and more or less regularly distributed.

Antennae.—Segments stoutish and strongly pilose; basal segment rufous the others black or rufous black; segments 2, 3, and 4 subequal, segment 3 only slightly smaller than the others.

Pronotum.—Punctures fine and black; impunctate midline distinct; lateral margins calloused, ochraceous; front half of pronotum declivent; entire dorsal surface somewhat convex; calli ill-defined.

Scutellum.—Lateral margins distinctly constricted at middle so that apical half-tapers abruptly; punctures fine and evenly distributed; tip paler but punctate; calloused areas at base not very distinct.

Osteolar Canal.—Distinctly elevated with the margins darker; pit prominent and black.

Legs.—Pale for the most part; the base of the femur maculated; the distal end of the tibia and proximal tarsal segments darker to rufous; last tarsal segment and claws black; all parts strongly and coarsely pubescent.

Body Pubescence.—Strong but sparse, mostly concentrated on head and pronotum; reduced on scutellum; margins of body with pubescence in silhouette.

Holotype female, July 18, 1935; allotype male, July 18, 1935.

LOCALITY.—Wet hillside about half a mile below the University of Wyoming Summer School grounds, left-hand side of road leading to Centennial, Wyoming. Holotype deposited in The American Museum of Natural History. Allotype and two paratypes in author's collection. Named after Dr. Alexander B. Klots.

AMERICAN MUSEUM NOVITATES

Number 936

Published by
THE AMERICAN MUSEUM OF NATURAL HISTORY
New York City

July 13, 1937

NEW AMERICAN SPIDERS

By W. J. GERTSCH

Pholcidae

Very few authentic species of *Pholcus* are known from the Americas though several names are still found in literature under that generic category which will ultimately be placed elsewhere. *Pholcus atlanticus* Hentz, described from the southern states, has been properly identified as a synonym of the cosmopolitan *Pholcus phalangioides* (Fuesslin), a common house spider throughout the United States. The species from Bermuda for which Marx used the name of the Australian spider *Pholcus tipuloides* Koch was referred to *Smeringopus elongatus* (Vinson) by Simon. This cosmopolitan spider has not as yet been reported from the United States. Only one authentic species of *Pholcus* in addition to *phalangioides* is known from North America. This, the recently described *Pholcus unicolor* Petrunkevitch from Porto Rico, is now known to occur in Mexico and southern Texas. At least two other species are found in Brazil and additional forms from the Americas may ultimately be referred to the genus. The discovery of a third North American species at Mendham, New Jersey, by Master Manuel Dos Passos, is of considerable interest. After a study of Hentz's figures of *atlanticus*, one of which shows the eye arrangement, and the new form described below, the evident differences preclude the possibility of identity.

Pholcus manuei, new species

Figures 6 and 7

FEMALE.—Total length, 4.50 mm.

	CARAPACE	FRONT	STERNUM	LABIUM	MAXILLA	ABDOMEN
Length	1.37	0.70	0.70	0.15	0.33	3.30 mm.
Width	1.34	0.45	0.86	0.28	0.15	2.30 mm.

Carapace white to dull yellow, with a large, divided, pale brown patch at the middle, the eyes ringed with black. Integument of the carapace sparsely clothed with erect black hairs. Clypeus with two pale brown longitudinal stripes. Sternum and labium dusky brown, the former with a central pale bar at the front margin and three pairs of distinct submarginal pale spots on each side. Maxillae somewhat dusky, the

coxae white. Clothing of the underside black hairs. Chelicerae pale brown, set with short black hairs. Abdomen concolorous with the carapace, without definite pattern, the clothing short black hairs.

Carapace suborbicular in outline as seen from above, the pars thoracica evenly convex, moderately high, the clypeus steeply sloping. Eyes elevated on a low tubercle. Ratio of the eyes: ALE : AME : PLE : PME = 12:8:12:12. First row of eyes seen from in front weakly procurved, the upper margins forming a straight line, the medians separated by about one-fourth their diameter, one-half their diameter from the larger laterals. Clypeus equal in height to more than the width of the first eye row (53/47). Posterior row of eyes moderately recurved, the medians separated by more than the diameter (12/16), subcontiguous with the laterals. Lateral eyes of one side and the posterior median subcontiguous, forming a triad. Median ocular quadrangle broader than long (36/21), narrowed in front (36/17). Sternum broadly truncated in front, truncated behind where the posterior coxae are separated by scarcely their length. Abdomen longer than broad, suboval, moderately high. Epigynum as illustrated in Fig. 7.

Legs long, without spines, evenly clothed with rows of black hairs.

	FEMUR	PATELLA	TIBIA	METATARSUS	TARSUS	TOTAL
I	6.15	0.60	6.50	9.35	1.50	24.10 mm.
II	4.65	0.55	4.35	6.15	1.00	16.70 mm.
III	3.70	0.40	3.20	4.55	0.80	12.65 mm.
IV	5.15	0.50	4.50	6.30	0.90	17.35 mm.

MALE.—Total length, 4.50 mm.

	CARAPACE	FRONT	STERNUM	LABIUM	MAXILLA	ABDOMEN
Length	1.40	0.90	0.75	0.14	0.35	3.10 mm.
Width	1.30	0.60	0.95	0.28	0.15	1.80 mm.

Coloration and structure in nearly complete agreement with the female. Eye tubercle more strongly elevated, clothed with short, erect, black hairs. Ratio of the eyes: ALE : AME : PLE : PME = 11 : 7 : 11 : 11. First row of eyes weakly procurved, the medians separated by one-fourth their diameter (2/7), about their radius from the lateral eyes (5/7). Posterior eye row very weakly recurved, essentially straight, the medians separated by more than the diameter (18/11). Median ocular quadrangle broader than long (40/22), narrowed in front (40/18). Clypeus equal in height to more than the width of the first eye row (65/50). Chelicera with a stout blunt tooth near the apex.

Palpus as illustrated in Fig. 6. Trochanter with a pale curved spur which is directed laterad.

	FEMUR	PATELLA	TIBIA	METATARSUS	TARSUS	TOTAL
I	7.35	0.60	7.35	11.00	1.80	28.10 mm.
II	5.35	0.50	5.15	7.35	1.10	19.45 mm.
III	4.30	0.50	3.70	5.40	0.85	14.75 mm.
IV	5.70	0.50	5.00	6.70	1.10	19.00 mm.

TYPE LOCALITY.—Male holotype and female allotype from the garage in the Dos Passos residence at Mendham, New Jersey, collected

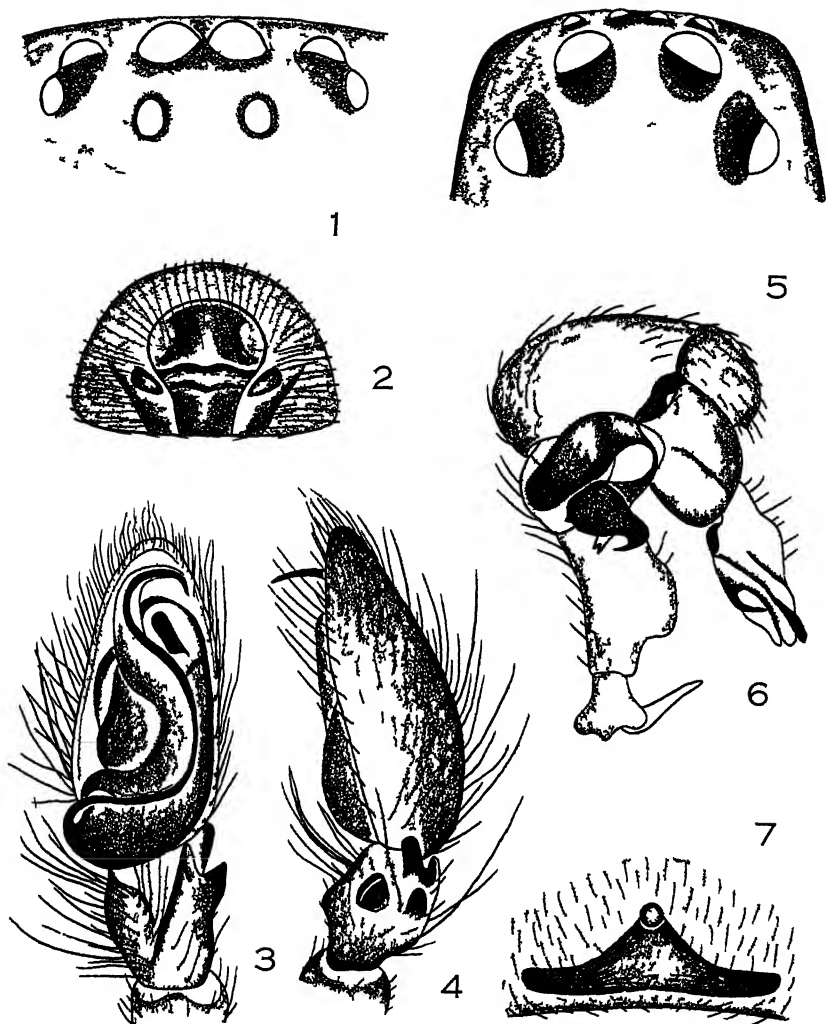


Fig 1 *Hesperauximus sternitzkii*, new species, eyes of male
 Fig 2 Idem, epigynum of female
 Fig 3 Idem, left male palpus, ventral view
 Fig 4 Idem, left male palpus, retrolateral view
 Fig 5 *Melocosa fumosa* (Emerton), eyes of female
 Fig 6 *Pholcus manueh*, new species, left male palpus retrolateral view
 Fig. 7 Idem, epigynum of female

April 18, 1937, by Manuel Dos Passos. Additional paratypes of both sexes from the same locality, April 28, 1937 (W. J. Gertsch). The types are in the collection of The American Museum of Natural History.

This species approximates *Pholcus phalangioides* (Fuesslin) closely in color and structure but is distinct in various respects. The eyes in both sexes are more closely grouped, the anterior medians being proportionately much nearer the laterals than in *phalangioides*, separated by much less than the diameter in both sexes. The posterior median eyes are correspondingly much nearer together in *manueli*, the separation being much less than two diameters. The apophyses of the bulb of the male palpus and the genital ridges of the female differ in form as illustrated in the figures.

Amaurobiidae

HESPERAUXIMUS, NEW GENUS

A genus of the subfamily Amaurobiinae.

Carapace longer than wide, heavy, very broad in front, strongly convex, the median groove longitudinal. First row of eyes very weakly procurved, the medians slightly larger and nearer each other than their distance to the lateral eyes. Second row of eyes weakly procurved, the eyes equidistantly spaced, the medians smaller. Median ocular quadrangle slightly broader than long, the anterior eyes much larger. Clypeus low, equal in height to the diameter of the anterior median eye. Chelicera with two teeth on the lower margin. Labium slightly longer than broad. Legs robust, strongly spinose, the tibiae unarmed above, with three pairs of ventral spines. Paired claws similar, with a single row of teeth, the median claw with a small denticle. Calamistrum uniseriate. Cribellum divided.

GENOTYPE.—*Hesperauximus sternitzkii*, new species.

This genus is apparently more closely allied to *Amaurobius* than other genera of the family but is distinct in the following respects: the eyes of the posterior row are equidistantly spaced; the labium is only slightly longer than broad; the lower cheliceral margin is armed with only two teeth; and the calamistral hairs are arranged in a single series. From *Callioplus* and *Titanoeca*, genera in which the calamistrum is also uniseriate, it may be separated by the much larger anterior median eyes which slightly exceed in size the anterior laterals and are much larger than the posterior medians. The genital organs in both sexes of *Hesperauximus* differ markedly from the types found in these genera.

Hesperauximus sternitzkii, new species

Figures 1 to 4

FEMALE.—Total length, 9.50 mm.

Carapace dark brown, the pars thoracica and the sides of the head nearly black,

clothed evenly with fine, subprocumbent white hairs with which are interspersed longer erect, black hairs most numerous in the ocular region. Carapace longer than wide, very broad in front, convex, the median groove a deep longitudinal depression which begins back at a point three-fourths of the total length. Sternum longer than broad, gently rounded on the sides, truncated in front, the first coxae separated by their length, more abruptly narrowed caudad of the third coxae to end in an acute point, the posterior coxae separated by three-eighths their width. Labium slightly longer than broad, four-sevenths as long as the endites. Clothing of the under side erect black hairs and a few soft white ones. Chelicera black, somewhat geniculate at the base, clothed with black hairs, the upper margin with four, the lower with two black teeth of which the inner one is larger.

	CARAPACE	FRONT	STERNUM	LABIUM	MAXILLA	ABDOMEN
Length	4.50	0.80	2.40	0.80	1.40	5 30 mm
Width	3.20	2.50	1.70	0.76	0.80	4.00 mm.

Eyes eight, in two rows, the ratio as follows: ALE : AME : PLE : PME = 20 : 23 : 18 : 15. First row of eyes weakly procurved, the large round medians separated by slightly more than their radius (13/23), about a diameter from the smaller oval laterals (21/23). Clypeus equal in height to the diameter of an anterior median eye. Second row of eyes broader than the first (75/88), slightly procurved, the round medians separated by three diameters (15/42), slightly nearer the oval laterals (15/41). Median ocular quadrangle slightly broader than long (70/60), narrowed in front (70/55), the anterior eyes much larger. Lateral eyes of each side separated by their radius.

Legs robust, armed with black spines, the first leg as follows: Femur, dorsal, 1-1-1, prolateral, 2 distal, retrolateral, 1 distal; tibia, prolateral, 1-1-1, retrolateral, 1-1-0, ventral, 2-2-2, the last pair distal; metatarsus, protateral and retrolateral 1-1, ventral 2-2-1, dorsal, 2-2, five of these spines forming a distal ring. Second and third tibiae with 2-2-2 spines, the fourth tibia with 1 median and a distal pair of spines. Last three femora with 1-1-1 dorsals, 1-1 prolaterals and retrolaterals. All tibiae unarmed above. First tarsus with a single row of trichobothria. Calamistrum a single series of curved hairs on a slight carina.

	FEMUR	PATELLA	TIBIA	METATARSUS	TARSUS	TOTAL
I	3.30	1.60	3.00	2.80	1.35	12.05 mm.
II	2.80	1.40	2.25	2.20	1.10	9.75 mm.
III	2.50	1.25	1.75	1.80	0.80	8.10 mm.
IV	2.80	1.38	2.30	2.20	0.90	9.58 mm.

Abdomen oval as seen from above, gray to yellowish brown in color, the sides dark, the dorsum with a basal hastate dark maculation and dark chevrons in the caudal half which are broken up into spots. Cribellum divided. Front spinnerets about as broad as long, contiguous at their bases, two-jointed, the distal joint very small. Posterior spinnerets more slender, two-jointed, the conical distal joint half as long as the basal. Epigynum as illustrated in Fig. 2.

MALE.—Total length, 8.75 mm.

Color and structure in nearly complete agreement with the female. First row of eyes very weakly procurved, essentially straight, the medians separated by one-

third their diameter (8/26), farther from the laterals (16/26). Clypeus equal in height to the diameter of an anterior median eye. Second eye row procurved, the eyes subequidistantly spaced. Median ocular quadrangle scarcely as broad as long (32/33), slightly narrowed in front (30/32). Ratio of the eyes: ALE : AME : PLE : PME = 26 : 21 : 19 : 16. Eye relations as illustrated in Fig. 1. Chelicera proportionately longer than in the female but the armature the same.

	CARAPACE	FRONT	STERNUM	LABIUM	MAXILLA	ABDOMEN
Length	4.30	0.95	2.40	0.83	1.40	5.00 mm.
Width	3.20	2.35	1.60	0.76	0.80	3.50 mm.

Legs somewhat more slender than in the female but the spinal arrangement the same. First leg: femur, 3.80 mm.; patella, 1.75 mm.; tibia, 3.95 mm.; metatarsus, 4.00 mm.; and tarsus, 1.75 mm. long. Male palpus as illustrated in Figs. 3 and 4.

TYPE LOCALITY.—Male holotype, female allotype and female and immature paratypes from near San Francisco, California, sent to me by Mr. R. F. Sternitzky for whom it is a pleasure to name this interesting species. The types are in the collection of The American Museum of Natural History.

Pisauridae

The curious spider described as *Lycosa fumosa* by Emerton seems to find its proper family position in the Pisauridae. This species parallels various lycosids closely in general appearance and superficial structure. A considerable resemblance is also evident in more important structures such as the male palpus in which the bulbal parts are more simplified and compact than usual in the family. The tibia of the palpus completely lacks the normal apophysis. The eye arrangement (see Fig. 5) is suggestive of species of *Dolomedes* and *Thaumasia* and other characters of the species seem to place *fumosa* near these genera in the Thaumasinæ.

MELOCOSA, NEW GENUS

A genus of the subfamily Thaumasinæ. Carapace somewhat longer than broad, the pars thoracica as viewed from above suborbicular, evenly convex, the pars cephalica half as wide as the greatest width of the carapace, the sides moderately convex. Clypeus equal in height to two-thirds the diameter of an anterior lateral eye. First row of eyes slightly narrower than the second, very weakly procurved (essentially straight), subequidistantly spaced a diameter apart, the laterals slightly larger. Eyes of the second row strongly recurved, the medians separated by scarcely a diameter. Posterior lateral eyes separated from each other by more than three diameters (5/18). Dorsal eye quadrangle much broader than long (23/12.4), very much narrowed in front (23/14.4), the anterior eyes (posterior medians) larger. Labium slightly longer than broad (10/9), the basal excavations one-third the length. Chelicera with three subequal teeth on the lower margin and three on the upper of which

the median is larger. Legs very long, the spines beneath the tibiae, 2-2-2. Fourth tibia with a stout basal spine. Tibia and patella of the fourth leg slightly longer than the fourth metatarsus (7.45 mm./7.15 mm.).

GENOTYPE.—*Lycosa fumosa* Emerton.

Melocosa is distinct from all other pisaurids in completely lacking an apophysis on the tibia of the male palpus. The presence of three teeth on the lower margin of the chelicera will separate it from *Dolomedes*.

***Melocosa fumosa* (Emerton)**

Figure 5

Lycosa fumosa EMERTON, 1894, Trans. Connecticut Acad. Arts and Sci., IX, p. 421, Pl. III, fig. 1.—CHAMBERLIN, 1908, Proc. Acad. Nat. Sci. Philadelphia, p. 272, Pl. XIX, figs. 2 and 3.

RECORDS.—Fairview Mountain, Lake Louise, Alberta, 8000-9000 feet, July 9, 1925, male and female (O. Bryant). Edmonton, Alberta, July, male.

There is a dried male of this species from the Bean collection which was determined by J. H. Emerton in 1894.

AMERICAN MUSEUM NOVITATES

Number 937

Published by
THE AMERICAN MUSEUM OF NATURAL HISTORY
New York City

July 13, 1937

NEW INSECTIVORES, *ELEPHANTULUS* AND *CROCIDURA*, FROM ANGOLA, AFRICA

BY JOHN ERIC HILL AND T. DONALD CARTER

Among the insectivores in the collections of the American Museum, secured by the Vernay Angola Expedition, 1925, and purchased from Mr. C. P. Chapman, Luimbale, Angola, 1928, are four apparently new forms. This is the third preliminary paper¹ on the Angolan collections.

As previously, measurements are given in millimeters and color terms are those of Ridgway, 1912, 'Color Standards and Nomenclature.'

Elephantulus intufi mossamedensis, new subspecies

TYPE.—No. 85664 Amer. Mus. Nat. Hist., ♂ adult, skin and skull, from 101 km. E. Mossamedes, Angola (railroad stop). Secured by the Vernay Angola Expedition (Mr. H. Lang, collector, orig. no. 222), July 6, 1925.

GENERAL DESCRIPTION.—A pale race of *E. intufi*, much paler than the race to the east and south, *E. i. alexandri* Ogilby.

COLORATION.—Back paler than cinnamon-buff, more grayish; the individual hairs plumbeous-black basally, followed by a narrow band of tilleul-buff, a band of blackish, then two bands of near cinnamon-buff, separated by a blackish band. Toward the rump the bands become less distinct and paler, the light bands near tilleul-buff. Naked rump patch bordered with numerous pure white hairs. Sides paler than back, becoming nearly cartridge buff next the underparts. (In *alexandri* of the same season and latitude the sides are darker and grayer than pinkish buff.) Postauricular patch near cinnamon-buff (near pinkish cinnamon in *alexandri*). Underparts white, gray-based except around mammae in females; lips white; an extensive white circumocular ring, and a white tuft at the anterior base of the ear-conch. Feet white. Under side of tail whitish to tip.

SKULL.—Agrees closely with that of *E. i. alexandri*.

MEASUREMENTS.—See table, p. 4.

Elephantulus i. mossamedensis probably occurs only between the littoral and the high escarpment of the interior; on the highlands to the east its relative, *E. i. alexandri*, is common.

Crocidura luimbalensis, new species

TYPE.—No. 85071, Amer. Mus. Nat. Hist., ♂ adult, skin and skull, from Luimbale, Angola. Collected by Mr. C. P. Chapman, orig. no. 17, October 7, 1926.

¹ See 1937, Amer. Mus. Novit. Nos. 913, 916.

GENERAL DESCRIPTION.—A medium-sized grayish-brown *Crocidura*, with ears relatively large; tail about half length of head and body; its basal three-fourths with scattered long hairs. Lateral glands well marked, covered with short dirty whitish hairs.

COLORATION.—New winter pelage: upperparts near drab faintly overlaid by bister; underparts near light grayish olive, fairly sharply set off from color of upperparts on the sides.

Worn summer pelage (molting): upperparts slightly duller than cinnamon-buff; underparts brighter than deep olive-buff. Feet pale. Tail, brownish above, dirty whitish below; "bristles" whitish.

SKULL.—Relatively massive. Interorbital region and rostrum broad. Greatest width at an angular ridge lateral to the petrosal bones. Palate extends behind M^3 for more than the antero-posterior length of that tooth. Mandible heavy, with slender angular process.

DENTITION.—First upper incisor with "hook" nearly vertical, rather than procumbent. Third upper unicuspid slightly larger than second, but lower; the entire posterior side closely approximated to the premolar, separated by a slit-like space rather than a medial angular "bay." M^3 moderately developed. Lower unispids large.

MEASUREMENTS.—See table, p. 4.

Only a single specimen of this shrew was secured. It appears to be most closely related to *Crocidura beirae* Dollman.¹ The color is different from *beirae* (described as "sepia mottled with neutral gray," worn pelage "near raw umber"), the tail shorter, braincase narrower and shallower, and the teeth smaller.

Crocidura cuanzensis, new species

TYPE.—No. 85558, Amer. Mus. Nat. Hist., ♂ adult, skin and skull, from Chitau, alt. 4930 ft., Angola. Secured by the Vernay Angola Expedition (Mr. Herbert Lang, collector, orig. no. 534), August 10, 1925.

GENERAL DESCRIPTION.—A small, dull brownish *Crocidura*, with white feet. Tail short, whitish, its "bristles" numerous, very fine, and present nearly to the end.

COLORATION.—Upperparts near wood brown, overlying slate gray. Underparts and lower sides near grayish olive (the olive color may be stain). Feet and tail sparsely covered with whitish hairs. Dorsal mystacial vibrissae blackish, ventral ones whitish.

SKULL.—Skull, although small, relatively broad and massive; rostral, interorbital and mastoid breadth being as great as in larger species, such as *turba*. Palate extends short distance behind M^3 , less than greatest antero-posterior length of the latter. Interpterygoid region relatively broad.

DENTITION.—First upper incisor moderately recurved, with a poorly developed talon. Third upper unicuspid slightly smaller than second, about height of anterior cusp of premolar. A large right-angled "bay" between canine and premolar on

¹ 1915, Ann. Mag. Nat. Hist., (8) XVI, pp. 69-70.

medial side. M^3 shorter in antero-posterior length and longer in transverse axis than corresponding tooth in *C. jacksoni denti*.

MEASUREMENTS.—See table, p. 4.

Only the type of this species was collected. It appears to be related to *Crocridura katharina* Kershaw¹ but it is darker, larger, with shorter tail. The skull is larger, with longer palate and broader rostrum.

Crocridura chitauensis, new species

TYPE.—No. 85566, Amer. Mus. Nat. Hist., ♀ adult, skin and skull, from Chitau, alt. 4930 ft., Angola. Secured by the Vernay Angola Expedition (Mr. Herbert Lang, collector, orig. no. 429), August 4, 1925.

GENERAL DESCRIPTION.—A small, short-tailed, fawn-colored shrew. Feet small. Tail with extremely delicate "bristle-hairs" almost to tip, pelage short, soft.

COLORATION.—Upperparts fawn color overlying drab-gray, dark neutral gray of bases of the hairs showing through. Underparts pale olive-gray, this color extending up on the sides and including the limbs. Feet whitish. Tail bicolored, above near hair brown, below dirty whitish.

SKULL.—Skull about size of that in *C. jacksoni denti* but more slender in inter-orbital region and rostrum. Palate short, ending on a level with posterior margin of M^3 (extending considerably behind this in most species). Interpterygoid region long, narrow. Braincase smaller, less rounded than in *C. j. denti*.

DENTITION.—First upper incisor with talon in contact with anterior side of first unicuspid, not functioning as a separate cusp. M^3 shorter in longitudinal axis, larger in transverse axis than in *C. j. denti*.

MEASUREMENTS.—See table, p. 4.

Only the type of this species was secured. Externally it is much like *C. cuanzensis* in coloration and appearance. It is smaller, however, with shorter bicolor tail; the palate does not extend behind M^3 ; the teeth are smaller. *C. chitauensis* is considerably darker than reported for *C. katharina*, the tail is shorter, but the cranial measurements are quite similar; possibly it may prove to be a race of *C. katharina*.

¹ 1922, Ann. Mag. Nat. Hist., (9) X, pp. 101-102.

<i>Elephantulus i. mosac-</i> <i>medensis</i> , n. subsp. (type)		Sex	Head and body	Tail	Hind foot (c. u.)	Skull Condylar-incisive length	Basal length	Palatal length	Length nasals	Zygomatic breadth	Interorbital breadth	Mastoid breadth	Height, basion to inion	Maxillary alveoli	P ³ - M ³	Breadth P ⁴	Outside breadth M ¹ - M ¹
A. M. N. H. 85664	♂	112	34	31.4	29.6	18.5	12.5	20.1	7.0	15.0	9.7	13.0	7.7	2.1	11.4		
<i>Crocodyrus nbalen-</i> <i>sigs</i> , n. sp. (type)							Breadth rostrum behind I ¹	Maxillary breadth				Length upper tooth row	P ⁴ -M ³	Breadth M ¹	Length I ² , anterodorsal margin.		
A. M. N. H. 85071	♂	103	15	2	21.4	10.4	3.0	8.1	4.7	10.4	2	10.4	5.9	2.4	2.0		
<i>Crocodyrus beirae</i> Doll.																	
man. Type ³	♂	103	16	25.3	21.7	10.5		7.8	4.6	10.7	6.8	10.9					
<i>Crocodyrus ciampensis</i> n. sp. (type)																	
A. M. N. H. 85558	♂	82	12	20.3	17.7	8.4	2.3	7.3	4.2	9.4	4.9	9.0	5.1	2.2	1.5		
<i>Crocodyrus chilensis</i> , n. sp. (type)																	
A. M. N. H. 85566	♀	75 ¹	11	20.0	17.0	7.7	2.1	7.2	4.0	8.9	4.9	8.8	5.0	2.2	1.5		
<i>Crocodyrus kalarina</i> Kershaw. Type ⁴		♂	68	11	20.0	7.8		7.1		9.0		8.1					
¹ Remasured fr m dry skin. ² Injured.			Mean Meas	Meas from Dollman, 1915. Meas from Kershaw, 1922													

AMERICAN MUSEUM NOVITATES

Number 938

Published by
THE AMERICAN MUSEUM OF NATURAL HISTORY
New York City

July 20, 1937

A NEW SPECIES OF HESPERIIDAE, AND NOTES ON OTHERS, FROM PANAMA

(LEPIDOPTERA-RHOPALOCERA)

By E. L. BELL

On their visit to Panama during part of February and March, 1936, Drs. F. E. Lutz and W. T. Gertsch and Mr. W. C. Wood collected a considerable number of HesperIIDae among a large number of other insects. The hesperiid material adds a number of species new to the American Museum collection, as well as providing additional specimens in other species poorly represented in the collection.

All three members of the party collected for some time on Barro Colorado Island, the well-known Biological Station in Gatun Lake, in the Canal Zone. Drs. Lutz and Gertsch spent several days on El Volcan, Chiriqui Province, in the extreme upper part of Panama near the Costa Rica border, where they collected in forest and open country at an altitude of approximately 4300 feet. Dr. Gertsch made a short trip to Cerro Punta, higher up on the mountain, where he collected in a forested canyon region at an altitude of approximately 6000 feet.

It is quite natural that the majority of the species collected have been previously recorded from the Central American region but it is also to be expected that the large amount of material they secured from a region so rich in the insect fauna might contain new records of distribution and even undescribed species. This expectation is fulfilled in one apparently undescribed species, the description of which will be found on another page of this paper, and in seven species which do not seem to have been previously recorded from Central America, and these are recorded here with notes on two others.

The species are distributed in two subfamilies, the Pyrginae and the Hesperinae. In the Pyrginae there are represented thirty-eight genera and seventy-three species and forms; in the Hesperinae forty-eight genera and seventy-nine species and forms. There also remains one unidentified female belonging in the Hesperinae.

All of the material, including the type of the new species, is in the collection of The American Museum of Natural History.

Pyrginae

Quadrus assecla (Mabille)

Pythonides assecla MABILLE, 1883, Ann. Soc. Ent. Belg., XXVII, C. R., p. lxxvi.

Described from "East Brasil." There are specimens in the Museum collection from French Guiana; Dutch Guiana; Brasil (Amazonian region); Peru; and Bolivia.

One male and one female collected on Barro Colorado Island, March 11-14.

Cyclosemia (?) *paulinus* (Cramer)

Papilio paulinus CRAMER, 1782, 'Pap. Exot.', IV, p. 211, Pl. cccxcx, figs. G, H.

Described from Surinam. Cramer's figures represent a female. This species is probably not congeneric with the type of *Cyclosemia*. There are specimens in the Museum collection from British Guiana; French Guiana; and Peru.

One male collected on Barro Colorado Island, March 19.

Ouleus cyrna (Mabille)

Achlyodes cyrna MABILLE, 1895, Ann. Soc. Ent. France, Bull., p. lvi.

Achlyodes simplex GODMAN AND SALVIN, 1895, 'Biol. Centr.-Amer.,' Rhop., II, p. 396, Pl. LXXXVI, figs. 15, 16.

Achlyodes fasciata GODMAN AND SALVIN, 1895, 'Biol. Centr.-Amer.,' Rhop., II, p. 396, Pl. LXXXVI, fig. 17.

Achlyodes cyrna GODMAN AND SALVIN, 1896, 'Biol. Centr.-Amer.,' Rhop., II, p. 430 (footnote). GODMAN, 1901, p. 635; and p. 739, (Supplement), 1901.

The type locality for *cyrna*, *simplex* and *fasciata* is Chiriqui. Godman and Salvin sank their *fasciata* as a synonym of *cyrna* Mabille and as *simplex* is the male of *fasciata* that name must also be sunk as a synonym of *cyrna*.

The two sexes differ somewhat in their superficial appearance, as shown by the Godman and Salvin figures of *simplex*, the male, and *fasciata*, the female, but this condition is found not infrequently elsewhere among the HesperIIDae.

Three males and two females were collected on El Volcan, February 22-25, March 7.

Hesperiinae

Rhinthon trimaculata (Herrich-Schäffer)

Cobalus trimaculata HERRICH-SCHÄFFER, 1869, Corresp.-blatt. d. zool.-min. Ver. Regensburg, XXIII, p. 200.

Hesperia trimaculatus Plötz, 1882, Stett. Ent. Zeit., XLIII, p. 327. Godman, 1907, Ann. and Mag. Nat. Hist., (7) XX, p. 139.

Cobalus trimaculata Draudt, 1923, in Seitz 'Macrolep. of the World,' V, p. 957, Pl. 185 i.

The original description does not give the type locality. Both Plötz and Draudt give Brasil. Draudt figures the species. The locality "Brasil" is very indefinite considering the vast area of that country extending over five degrees above and nearly thirty-five degrees of latitude below the equator and nearly forty-five degrees of longitude wide in the northern part, but in the writer's collection there are a male and two females of this species from Massaranduba-Blumenau and Hansa-Humboldt, both in the Province of Santa Catharina, south Brasil, and Godman states that there is a male specimen in the Godman and Salvin collection from Minas Geraes, which is also located toward the southern part of Brasil. Both of these Brazilian Provinces are far removed from northern Panama.

The male has the usual stigma on the primaries, a line of raised scales along the upper side of vein 1 in the basal half, and rather indistinct.

One male was collected on El Volcan, February 24, and has the cell spots of the primaries formed by two short, white streaks one above the other; the two discal spots are rather small. In the male from Massaranduba-Blumenau the two stripes of the cell are heavier and narrowly joined in the center; the two discal spots are much larger than in the El Volcan specimen, especially that in interspace 2.

Whether or not this difference in maculation constitutes a constant racial character cannot be decided from the single male collected. The form of the male genitalia is identically the same in the specimens from both localities.

Eutychide gertschi, new species

Figure 1

The single male taken superficially more closely resembles *Oeonus degener* Plötz than any of the *Eutychide* species with which the writer is familiar, but the stigma of the primaries is differently formed than that of *degener*. The form of the stigma is similar to but not developed as much as that usually found in *Eutychide*, it consists of a straight, narrow stripe in the base of interspace 2, lying close under the cell, not reaching as far upward as the rise of vein 3, this stripe is widened a little at its base and produced a very little along the upper side of vein 2; another short, longitudinal stripe lies just below vein 2; a still shorter stripe lies just above vein 1.

Upper side dark brown. Primaries with a very narrow, oblique spot near the base of interspace 2; another small, roundish one in the basal third of interspace 3,

both white and semi-hyaline. A very minute white subapical spot near the base of interspace 6. There are long hairs at the base of the wings below the cell and along the inner margin below vein 1. Secondaries immaculate, with long hairs at the base and along the abdominal fold. Fringes of both wings brown, those of the secondaries paler at the tips.

Beneath reddish brown. Primaries darkened in the basal third below the cell. Spots of upper side repeated and a little larger, and in addition there is a minute, ill-defined subapical spot in interspace 7, and a minute accumulation of yellowish scales in the cell on the upper border in the apical third, and a diffuse, elongate spot of yellow scales in interspace 1 below the semi-hyaline spot in interspace 2. Secondaries with a small but very noticeable yellow spot near the end of the cell and a curved discal row of three very minute yellowish dots, the upper one opposite the end of the cell and the others below it, one in each interspace; below these is a small, hazy accumulation of darker fulvous scales not forming a definite spot.



Fig. 1. Male genitalia of *Eutythide gertschi*, new species.

Upper side of body dark brownish, abdomen with some dark fulvous hairs. Top of head and collar black and fulvous with green hairs intermixed. Tegulae brown along the sides, blackish at the base and along inner margin and mixed with green. Beneath: palpi mostly fulvous and black with a greenish reflection at the base. Pectus and thorax dark reddish fulvous with greenish reflections. Abdomen brown with fulvous hairs in the center. Antennae black above; beneath the basal half of the club is fulvous and the shaft minutely spotted with that color at the joints.

Expanse.—32 mm.

HOLOTYPE.—Male, El Volcan, Chiriqui, Panama, February 23, 1936.

This species is named for Dr. W. T. Gertsch, who collected the specimen.

In the male genitalia the uncus is very broad at the apex, where on each side it has a small triangular flange, there are two ventral arms projecting downward and curving forward and terminating in a sharp point. The girdle is long and slender. The saccus short and slender. The claspers are short, the left one with the apex turned upward, on which there are small teeth and back of which a stout tooth projects upward; the right clasper is apically a little rounded toward the back and also carries small teeth followed by a stout tooth similar to that of the left clasper. The aedoeagus is rather long and stout.

Phanes almoda (Hewitson)

Hesperia almoda HEWITSON, 1866, Trans. Ent. Soc. London, p. 499.—1869, 'Exot. Butt.,' IV, *Hesperia*, Pl. iv, fig. 35.

Phanes almoda GODMAN, 1900, 'Biol. Centr.-Amer.,' Rhop., II, p. 549.

Hewitson merely stated that his type was in the Boisduval collection and gave no locality from whence it came, nor did he give one in his subsequent mention of *almoda* in 'Exotic Butterflies.' Godman mentions Venezuela and Guiana. There are specimens in the writer's collection from French Guiana; Trinidad, B. W. I.; and southern Brasil.

Two males collected on Barro Colorado Island, March 13-17.

Phanes rezia (Plötz)

Hesperia rezia PLÖTZ, 1883, Stett. Ent. Zeit., XLIV, p. 35.

Plötz gives Brasil as the type locality. There is a male specimen from British Guiana in the writer's collection.

Three females collected on El Volcan, February 22-28.

Phlebodes tiberius (Möschler)

Apautus tiberius MÖSCHLER, 1882, Verh. der k.-k. zool.-bot. Ges. Wien, XXXII, p. 329.

The specimens collected on El Volcan differ considerably from typical and possibly represent a local race or form. The males differ principally on the under side of the wings. On the primaries beneath the apical area is more yellowish brown and the darkened discal and basal areas are more intensely black. On the secondaries there is a red-brown outer marginal band, narrow at the inner angle and widening toward the anal angle, the area from the inner margin of this band to the base of the wings is reddish yellow, a little more reddish at the base itself, the usual discal band of small spots is almost obliterated and but barely seen where the paler basal area meets the red-brown marginal band; the usual yellow veins are but feebly indicated in the marginal band.

The females differ on the upper side of the wings from typical females in the very minute and somewhat darker yellowish discal spots of the primaries, the subapical dots either absent or very minute. On the under side of the wings the primaries have the apical veins but feebly paler than the ground instead of prominently yellow. On the secondaries the veins are but little lighter than the ground and the spots of the discal band are very small and the whole under side of these wings presents a very diffuse appearance.

Möschler's type came from Surinam but the species has a very wide distribution, extending from Mexico to southern Brasil, and is very

variable in maculation, appearing in several distinct forms which seem to represent well-defined races in some localities. The darkest individuals the writer has seen, and which have the spots of the primaries reduced in size, are those from Central American localities, the northern part of the range, and these, with the exception of the specimens from El Volcan, are assignable to the typical form of *tiberius*. Such specimens have no spots on the upper side of the secondaries or there is but the haziest indication of them. Evidently this form extends into the northern part of South America as Möschler's description very well fits the Central American insects, but several other forms also appear in this region, more pronounced in the males than in the females, and they vary on the upper side in the larger size of the discal spots of the primaries and on the secondaries in having small, somewhat diffuse discal spots to a well-defined, orange discal band with the spot opposite the cell produced inwardly to or slightly into the cell; and on the under side in having the ground color of the secondaries brown with prominently contrasting yellow veins to having the basal area variably suffused with yellow and the veins not so prominently yellow. The *reticulata* of Plötz is represented by those individuals in the males having larger discal spots on the primaries and a well-developed discal band of the secondaries, with the elongated spot opposite the cell, or in having three well-defined discal spots of these wings on the upper side; and on the under side in having the basal area yellow, or partly yellow, or brown, and yellow veins. South Brazilian specimens differ considerably from those from the more northern localities in having larger discal spots of both wings, the elongate spot of the band of the secondaries sometimes reaching almost to the base of the cell, and on the under side the whole basal area of the secondaries is pale cream-color, almost white, with a few small reddish spots near the base and an outer marginal band of the same color.

A study of the male genitalia in five distinct forms of *tiberius* results in finding not the slightest difference of specific value among them. A peculiar character of the male genitalia is found in dense patches of long hair-like bristles which arise from the back of the tegmen and extend forward over the base of the uncus. These bristles are easily removed and unless they are recognized for what they are may be removed during the process of cleaning the parts preparatory to making the slide and lost; however, if they have been accidentally removed, the place on the tegmen from which they arose is plainly indicated by an area of black dots.

Two males and three females of the peculiar form mentioned were collected on El Volcan, February 20-25, March 6.

Euroto potaro Williams and Bell

Euroto potaro WILLIAMS AND BELL, 1931, Trans. Amer. Ent. Soc., LVII, p. 277; p. 278, Fig. 29, male gen.; Pl. I, fig. 10.

Described from British Guiana and there are also specimens in the writer's collection from French Guiana; Trinidad, B. W. I.; and southern Brasil.

One male and three females collected on Barro Colorado Island, March 10-16.

Eutocus lucia (Capronnier)

Carystus lucia CAPRONNIER, 1874, Ann. Soc. Ent. Belg., XVII, p. 35, Pl. I, fig. 9.

Described from Therezopolis, Brazil. There are specimens in the writer's collection from Bolivia and southern Brasil.

Two females collected on El Volcan, February 19-23.

AMERICAN MUSEUM NOVITATES

Number 939

Published by
THE AMERICAN MUSEUM OF NATURAL HISTORY
New York City

July 21, 1937

BIRDS COLLECTED DURING THE WHITNEY SOUTH SEA EXPEDITION. XXXV¹

NOTES ON NEW GUINEA BIRDS. II

By ERNST MAYR

This paper continues the review of the non-passerine families of the Papuan Region initiated in an earlier paper. Again a considerable portion of the studied material was collected by the Whitney South Sea Expedition or associated expeditions.

The present paper contains notes on species of the families Cuculidae, Tytonidae, Strigidae, Podargidae, Caprimulgidae, Alcedinidae and Bucerotidae. I am much obliged to Mr. J. L. Peters of the Museum of Comp. Zool., Cambridge, and Dr. E. Stresemann of the Zool. Museum, Berlin, for the loan of valuable specimens for comparison, and to Dr. Junge for notes on specimens in the Leiden Museum.

CUCULIDAE

Cuculus canorus Linnaeus

There are quite a number of old records of this species for the Papuan Region, but I have not seen a single specimen in the many recent collections that have gone through my hands, in fact I have never seen an authentic specimen from the New Guinea region. It is possible that some of the old specimens really belonged to *C. optatus*; they should be reexamined.

Eudynamis scolopacea rufiventer (Lesson)

Stresemann, summarizing what was in 1923 known about the distribution of this form (Arch. f. Naturgesch., LXXXIX, fasc. 8, p. 44) states that the range of *rufiventer* is as follows: "Misol, Salawati, Batanta, from N. W. New Guinea eastward on the south coast at least as far as Hall Sound, on the north coast as far as Astrolabe Bay; Dampier Island." He does not mention *minima* van Oort, but says that *rufiventer*

¹ Previous papers in this series comprise American Museum Novitates, Nos. 115, 124, 149, 322, 337, 350, 356, 364, 365, 370, 419, 469, 486, 488, 489, 502, 504, 516, 520, 522, 531, 590, 609, 628, 651, 665, 666, 709, 714, 820, 828, 912, 915, and 933.

is represented in Eastern New Guinea by *cycanocephala* whose range is as follows: "Northern Australia and southeast New Guinea, westward along the north coast at least as far as the Kumusi River, on the south coast as far as the foothills of the Owen Stanley Range."

The fact that the Archbold Expedition of 1933 obtained both forms at Daru has caused Mayr and Rand (1937, Bull. Amer. Mus. Nat. Hist., LXXIII, p. 67) to suspect that *cycanocephala* occurs in New Guinea only as a migrant, and that the range of *rufiventer* extends all over New Guinea (excepting the range of *minima*). A renewed examination of the material of the Rothschild Collection has fully confirmed this opinion.

No significant differences either in size or coloration of the females could be found between birds from west, north and southeast New Guinea.

The size of wing and tail of fully adult males of *rufiventer* from various localities is as follows: Arfak, wing 197, tail 185; Geelvink Bay, wing 186, 193, tail 167, 190, 196; Dampier Island, wing 188, 192, 195, 196, 199, 199, tail 164, 176, 187, 188, 189, 191; Wau, Morobe district, wing 187, 187, 190, 190, 191, 195, tail 182, 182, 183, 191, 195; southeast New Guinea, wing 190, 192, 195, tail 192, 196, 198; lower Digul, wing 187, tail 180; an adult male from Keku, Astrolabe Bay (March 26) measures, wing 201, tail 183, and may not belong to *rufiventer*. The combined measurements of these twenty birds are as follows: wing 186-199 (192.0), tail 164-198 (186.0).

For adult females I find the following measurements: Arfak (?), wing 178, tail 172; Ron Island, wing 188, tail 172; north New Guinea, between Mamberano and Astrolabe Bay, wing 185, 188, 188, tail 167, 176, 176; Dampier Island, wing 181, 184, 187, 188, 188, 191, 192, 195, tail 173, 175, 175, 176, 177, 178, 186, 188; Surprise Creek, Morobe district, wing 187, tail 185. The combined measurements of these 14 birds are, wing 178-195 (186.6), tail 167-188 (176.5).

Much smaller is apparently *Eudynamis scolopacea minima* van Oort known from only a few specimens, from the Noord River (south New Guinea), in which the adult has a wing shorter than 180 mm.

Eudynamis scolopacea subcycanocephala Mathews

All the specimens of "*cycanocephala*" collected in New Guinea, for which I could find records, were obtained in the months of March, April, June, and August, that is in the Australian winter. Two adult males measure, wing 202, 205, tail 192, 193, and two females wing 198, 212, tail 188, 191. Compare also the measurements given by Mayr and Rand (*op. cit.*, p. 66).

These measurements agree quite well with specimens from Cape York and northwest Australia (type-locality of *subcyanocephala*), but are definitely smaller than those of birds from New South Wales and southern Queensland. Such birds measure: wing ♂ 213–226 (220.7), ♀ 207–222 (213.1). It seems therefore probable that the majority of the birds that winter in southern and eastern New Guinea (between Fly River and Huon Gulf) belong to *subcyanocephala* from northern Australia. Salvadori has already listed specimens of both *rufiventer* and of *cyanocephala* from the Fly River and from southeast New Guinea although he records them all as *cyanocephala* ('Orn. Pap. Mol.,' I, p. 368).

***Centropus bernsteinii manam*, new subspecies**

TYPE.—No. 450939, Amer. Mus. Nat. Hist.; ♂ ad.; Vulcan (= Manam) Island, German New Guinea; December 7, 1913; A. R. Meek.

Similar to *C. b. bernsteinii*, but larger.

		WING	TAIL
Vulcan Island	♂ ad.	179, 180, 182, 190	243, 260, 262, 275
	♀ ad.	189, 192, 201	266, 269, 270
North New Guinea	♂ ad.	160, 166, 168, 172	218, 238, 243, 245
		173, 175, 176, 179	247, 252, 252
	♀ ad.	179, 181, 183	251, 263, 265

RANGE.—Vulcan (= Manam) Island, Mandated Territory of New Guinea.

The New Guinea material examined by me was all collected in north New Guinea between Humboldt Bay and Huon Gulf, except for one female (183, 265) from the Setekwa River. I therefore asked Dr. Junge for measurements of specimens in the Leiden Museum, which he kindly forwarded to me. The type, a female has a wing of 175 mm., 2 immature males from the Noord River measure 166, 170, and an adult male, also from the Noord River, has a wing of 185. All these specimens except the last named fit in with my own measurements. Either this Noord River bird is wrongly sexed, or specimens from south New Guinea are larger than such from north and west New Guinea.

Centropus phasianinus

Up to ten years ago all the New Guinea representatives of the Australian species were considered to belong to *Centropus nigricans*. In 1927, Stresemann showed however (Ornith. Monatsber., XXXV, p. 111) that specimens from south New Guinea (Merauke District) were quite different from typical *nigricans* Salvadori (type-locality Yule Island and

Hall Sound) and were in fact intermediates between *nigricans* and *phasianinus*. The characters of this race *thierfelderi* were confirmed by Mayr and Rand (1937, Bull. Amer. Mus. Nat. Hist., LXXIII, p. 69).

An examination of the entire material of the Rothschild Collection and of the American Museum has convinced me that *nigricans* is restricted to the south coast of southeast New Guinea and that two additional races must be described from the remainder of the Papuan range.

***Centropus phasianinus obscuratus*, new subspecies**

TYPE.—No. 223654, Amer. Mus. Nat. Hist.; ♀ ad.; Fergusson Island; November 24, 1928; Whitney South Sea Expedition (Hannibal Hamlin).

Similar to *nigricans*, but averaging larger; general coloration darker, more blackish; scapulars and inner secondaries blackish with just a trace of buff vermiculation; buff bars on the outer webs of the primaries very narrow; no bars at all on the inner webs of the primaries, except in one specimen out of five, where they are quite inconspicuous.

Wing, males (?) 220, 222, 225, females (?) 237, 247; tail, males (?) 302, 322, females (?) 313, 321; against: wing, males 203–221 (212.6), females 220–235 (229.2); tail, males 278–316 (298), females 302, 322, 341, in *nigricans*.

RANGE.—Fergusson and Goodenough Islands, D'Entrecasteaux Archipelago, and possibly north coast of southeast New Guinea.

This is the darkest race of *phasianinus*, unless *spilopterus* (Kei Is.) is also included in that species. More material must be examined before the differences in size can be determined exactly. Some of the present material is apparently wrongly sexed.

A male from Annie Inlet near East Cape (wing 212, tail 286) and a female from Kumusi River (wing 232) have the same color characters as the D'Entrecasteaux birds, but are smaller.

***Centropus phasianinus propinquus*, new subspecies**

TYPE.—No. 293675, Amer. Mus. Nat. Hist.; ♂ ad.; Ifar, Sentani Lake; September 28, 1928; Ernst Mayr.

Very similar to *C. ph. nigricans*, but smaller; in coloration not separable from some specimens of the variable *nigricans*; scapulars and inner secondaries with buff undulating cross-bars, sometimes almost as well marked as the upper wing-coverts, not more or less black, as in fully adult *nigricans*; whitish buff bars on outer webs of primaries broad and well defined; bars on underside of wing narrow and obscure; bars on upper tail-coverts and tail well developed; crown, nape and under parts pure black; very little rufous in plumage.

Wing, males 196, 203, 204, female 223; tail, males 261, 266, 270, female 301.

RANGE.—Only specimens from the type-locality examined, but all the specimens of this species collected in north New Guinea between Astrolabe Bay and Mamberano River probably belong to this race.

TYTONIDAE

Tyto tenebricosa arfaki Schlegel

An examination of 20 specimens of *arfaki* reveals that *arfaki* is very different from *tenebricosa* (of Australia), but that there are no races in the Papuan Region. Lord Rothschild has already pointed out the invalidity of Mathews' *perconfusa* (1917, Bull. Brit. Orn. Club, XXXVII, p. 17).

Nine males from the south coast of southeast New Guinea (Angabunga, Aroa, Port Moresby) (up to 6000') are on the average rather dark; the white spots on the upper parts are small, there is some extent of light mottling in three or four birds; the coloration of the under parts is rather more variable, some specimens being very dark and only a little spotted, others are profusely mottled with white.

Two trade-skins (males) from the Arfak average lighter, with more white mottling above and below.

Among the females, there is more variation. Three females from southeast New Guinea (Aroa River) are rather dark, little mottled. They are similar to a female from Wasior, Wandammen, and to two from Sattelberg.

Lighter and with a considerable amount of white mottling on the upper parts is a fourth female from the Aroa River; similar to this bird is on the upper parts a female from Kampong baru, Japen, which has much coarser and bigger white marks on the under parts, while a female from Collingwood Bay is not quite as light on the under parts, but has the most conspicuous white vermiculation on upper parts, wing and tail. These latter two birds are the lightest in the entire series. The distribution of these variants shows that this is a matter of individual, not geographical variation.

WING, ♂ — Southeast New Guinea 260, 254, 255, 256, 259, 254, 258, 254; Arfak 259, 250; Sattelberg 259.

WING, ♀ — Southeast New Guinea 285, 289, 305; Collingwood Bay 271; Sattelberg 280; Wasior 289; Japen 280.

STRIGIDAE

Ninox theomacha theomacha (Bonaparte)

Spots on the lower abdomen and on the scapulars are more frequent in birds from southeast New Guinea than in such from northwest New Guinea. Individual variation is, however, too strong to permit the recognition of *terricolor* Ramsay.

Ninox theomacha goldii from the D'Entrecasteaux Archipelago is a

well-pronounced race. Hartert was of the opinion (1918, Novit. Zool., XXV, p. 325) that *rosseliana* Tristram could not be separated from *goldii*. I find, however, that most specimens of *rosseliana* have the white spotting of the under parts more pronounced, the uniformly colored zone on the breast more restricted, and the thighs lighter and clearer ochraceous. Some specimens are indistinguishable.

***Ninox connivens assimilis* Salvadori and D'Albentis**

Two specimens from Vulcan Island are very dark, with broad rufous stripes on the under parts and under wing-coverts (see Rothschild and Hartert, 1915, Novit. Zool., XXII, p. 41). A female from Dampier Island is not as deeply colored and can be matched by a specimen from Veimauri, Galley Reach, southeast New Guinea. Three other birds from southeast New Guinea are still paler, but all these differences seem insufficient for subspecific splitting.

Ninox albomaculata Ramsay is a synonym of *assimilis*. Ramsay's original description as well as Kinghorn's detailed discussion (1933, Records Austr. Mus., XVIII, pp. 452-454) apply in every respect to our specimens of *assimilis*. Kinghorn had apparently no specimen of *assimilis* before him, when he suggested *albomaculata* might be a subspecies of *boobook*.

***Ninox rufa humeralis* (Bonaparte)**

This species fades rapidly in collections. Five males and five females, mostly from southeast New Guinea, measure as follows: wing, ♂, 326, 327, 329, 332, 337, ♀, 306, 310, 313, 314, 314; tail, ♂, 198, 203, 208, 210, 214, ♀, 186, 194, 198, 199. There is no difference between nine specimens from eastern, and one from western New Guinea.

UROGLAUX, NEW GENUS

TYPE.—*Aithya dimorpha* Salvadori.

Medium-sized, with a hawklike appearance and a very long tail; tail about two-thirds of the length of the wing (index 63.5-72.7), against one-half or more (index 49-63) in the species of the genus *Ninox*; tail slightly rounded; cere quite inflated, nostrils small; tarsus very heavily feathered, feathers covering even the basal phalanx of the toes; bristles on the bare part of the toes only weakly developed; wing very round ($5 > 4 > 6 > 3 > 7 > 2$), the fifth primary being the longest, while in all the species of *Ninox* either the third or fourth primary is longest; the sixth primary is longer than the third, while in *Ninox* it is slightly or very much shorter; the emargination on primaries 2, 3 and 4 is weak, on 5 and 6 it is inconspicuous; the bases of the feathers of the crown are white; the pattern of coloration, consisting of bars on the upper parts and stripes below, is quite different from that of any species of the genus *Ninox*.

The first specimen that was brought to me by a New Guinea native was first mistaken by me for a hawk. Dr. Hartert, who was such a genus lumper, suggested already in 1930 (Novit. Zool., XXXVI, p. 110) that *dimorpha* should be separated generically from *Ninox*.

CAPRIMULGIDAE

LYNCORNIS

This genus is supposed to differ from *Eurostopodus* by the presence of ear-tufts and by the more pointed wing. A close examination of several species of *Lyncornis* and *Eurostopodus* has convinced me that this difference is very slight and that the Papuan species *papuensis* and *archboldi* (both of which have no appreciable ear-tufts) must be included with *Eurostopodus* (April, 1838). If the genus *Lyncornis* (August, 1838) is to be recognized at all, it must be used for the group of species which includes *cerviniceps*, *macropterus* and *macrotis*.

Eurostopodus papuensis (Schlegel)

Three specimens from Astrolabe Bay (Beck coll.) differ clearly from a series of three birds from northwest New Guinea. They are darker, with all the black markings broader and coarser. The rufous spotting is paler, more clay-colored, less rufous. The differences of the under parts are less pronounced. The population from Astrolabe Bay will probably have to be called *elegans* Reichenow, although the type of *elegans* is a very unusual specimen, as Stresemann has already remarked (1923, Arch. f. Naturgesch., LXXXIX, fasc. 8, p. 31).

The principal characters of the type specimen of *elegans*, which Dr. E. Stresemann has very kindly loaned to me, are as follows, as compared to typical specimens: center of crown with round black spots, instead of longitudinal streaks; tertials and most of the upper wing-coverts unspotted vinaceous-rufous (a sort of pale milk-chocolate color), very soft; breast and belly of the same color, without black bars or well-defined rufous spots; central tail-feathers dark rufous with the black markings much reduced. This unusual plumage is undoubtedly the juvenal plumage. The softness of the feathers indicates this clearly which is particularly evident at the upper and under tail-coverts which are quite downy. Some of the lesser upper wing-coverts and scapulars apparently belong to the adult (or a sub-adult) plumage. They are marked very similarly to those of normal birds. I do not know of any other species in the family *Caprimulgidae* in which the juvenal plumage is as different from the adult as in this case.

Eurostopodus Astrolabae was described by Ramsay (1883, Proc. Linn. Soc. New South Wales, VIII, p. 20) without any reference to "*Lyncornis*" *papuensis*. The description, given by Ramsay, applies very well to our northwest New Guinea specimens of this species, but only an actual comparison of specimens can determine, whether or not there is an endemic race of this species in southeast New Guinea.

***Eurostopodus mystacalis* (Temminck)**

There are only very few New Guinea records of this species. The dates at which these specimens were collected are all, so far as I know, in the Australian winter. It seems more than probable that the species occurs in the Papuan Region only as a winter visitor.

PODARGIDAE

***Podargus papuensis* Quoy and Gaimard**

In 1927 Dr. Stresemann described a small specimen of this species from south New Guinea as *pumilus* as differing from *papuensis* by smaller size (wing 258-264, against 278-302 in *papuensis*). Additional material from south New Guinea fully confirmed the small size of this population. Mayr and Rand record the wing measurements of a series from the Oriomo River as ♂ 272, 282, ♀ 264, 267 (1937, Bull. Amer. Mus. Nat. Hist., LXXIII, p. 71).

In the meantime, however, it has become known that the size variation of this species is rather irregular in relation to geographical distribution. In 1932 I measured in the Brit. Museum a series from Cape York as follows: 262, 275, 278, 280, 285, 285, 296, 298, 299. These birds show no differences in coloration in comparison with south New Guinea birds and, although still more variable, include the entire range of variation of the series from the Oriomo River. These birds from Cape York have been named *rogersi* (= *baileyi*) by Mathews and it seems impossible to keep *pumilus* Stresemann subspecifically distinct.

In 1932 Stresemann and Paludan reported on the birds collected by Stein on the islands of Geelvink Bay (Novit. Zool., XXXVIII, pp. 200 and 233) and found that on Numfor (♀ 252, 275, 282) and Japen (♂ 277, 277, 280, ♀ 273, 273, 280) populations are found which are considerably smaller than those on the mainland of New Guinea. In fact these measurements agreed much better with those of "*pumilus*" and *baileyi* than with those of typical north New Guinea *papuensis*. There were two alternatives of taxonomic treatment. Either all the populations with small measurements (average of wing-length of males below

285) could be treated as belonging to one subspecies notwithstanding the irregular and disrupted distribution which would result, or else this size variation would be considered as being below the threshold of subspecific recognition. Stresemann and Paludan chose the latter course and included the small island population with typical *papuensis*. After a study of a large amount of material Mayr and Rand (*loc. cit.*) followed this lead and also called birds from the entire range *papuensis*. Small size variations are important and should be mentioned in taxonomic papers. It is, however, undesirable to affix names to such size variants unless there is some trend in this variation which results in a clear cut separation of ranges. If the recognition of such size race, however, leads to a distributional map which resembles a checkerboard, it is better to refrain from the usage of subspecific names.

The following tabulation of additional measurements from specimens in the Rothschild Collection, Brit. Mus., and Amer. Mus. serve to illustrate the above discussion. The populations are arranged according to size:

Misol, ♂ 270, ♀ 254, 261; Merauke district, ♂ 264, ♀ 258; Oriomo River, ♂ 272, 282, ♀ 264, 267; Numfor, ♂ 273, ♀ 252, 275, 282; Aru Islands, ♂ 272, 282, 284, ♀ 262, 269, 283; Japen, ♂ 277, 277, 280, 280, 286, ♀ 263, 272, 273, 273, 280; Sepik River, ♂ 276, 291, ♀ 278, 283; Mimika and Setekwa River, ♂ 283, 283, 291, ♀ 269, 280; Cape York, (Rothschild Collection) ♂ 287, 289, 290, 291, 296, 300, 300, 303, ♀ 265, 268, 274, 274, 275, 277, 277, 278, 280, 281, 281, 283, 283, 284, 286, 290; head of Geelvink Bay, ♂ 283, 286, 294, 294, 296, 303, ♀ 269, 281; Arfak and Vogelkop, ♂ 294, 307, ♀ 287, 293, 304; Waigeu, ♂ 301, 303, ♀ 292; Astrolabe Bay, ♂ 297, 299, 309, ♀ 287, 291; north coast of southeast New Guinea, ♂ 300, 302, 303, 307, 308, ♀ 282, 309, (♀!); south coast (Rand and Mayr, *loc. cit.*) ♂ 291, 296, 298, 299, 305, 312, 312, 317, 321, ♀ 274, 280, 282, 283, 292, 295; south coast (additional material), ♂ 306, 311, 313, 324 (Aroa River), ♀ 282, 284, 287, 288, 289, 291, 291, 294, 294, 295; Salawati, ♂ 317.

AEGOTHELES

The two recent partial revisions of the New Guinea members of this genus by Mayr and Rand (Amer. Mus. Novit., No. 814, p. 4, and, Mitt. Zool. Mus. Berlin, XXI, pp. 242-243) will have to be emended in one respect. The oldest specific name for the New Guinea forms, which used to be included in *cristatus*, is *bennetti*, which has page priority over *affinis*.

ALCEDINIDAE

Halcyon macleayii Jardine and Selby

Stresemann (1923, Arch. f. Naturgesch., LXXXIX, fasc. 8, p. 38) records two races from New Guinea, the blue *elisabeth* from Astrolabe Bay and the typical *macleayii* from eastern and southern New Guinea, possibly only as migrant. The fact that we had both blue and greenish-blue birds from eastern New Guinea led Rand and me to the conclusion that both were color phases of one form and that all New Guinea birds were winter visitors from Australia (1937, Bull. Amer. Mus. Nat. Hist., LXXIII, p. 84). A renewed examination of the literature and of our entire material has brought me to a different conclusion. An examination of 18 specimens from New South Wales, of 25 specimens from Queensland and of 12 specimens from Cape York showed that none of these birds was even nearly as blue as some New Guinea specimens. In fact the greenish-blue coloration of the back was fairly uniform. Wear did not change the color of the back to a very great extent. As has been known for a long time, some individuals of this race migrate to the Papuan Region and the Bismarck Archipelago. The greater majority, however, seems to remain in Australia. Of fourteen dated specimens from New South Wales, only four were collected during the breeding season (November), the other ten during the southern winter (May 5, July 2, August 1, September 2). The entire series of Cape York birds (except for one specimen with a wing of 91) consists of small birds with a wing of 87–89 mm. ("*barnardi* Campbell"), while six of twelve New South Wales birds have a wing of 93 mm. or longer. The entire New South Wales series measures 89–96 (av. 91.9).

Of the forty-four Papuan specimens of this species in the A. M. N. H. Collection (including the Rothschild Collection) thirty-two seem to be migrants from Australia. They can in no way be distinguished from a series of New South Wales birds. They are: 1 ♀ imm., Baroka, Bioto Creek, April 17; 1 ♂ ad., Naiabui, Hall Sound, September 1; Aroa River, 1 ♂ ad., May 6, 1 ♀ imm., April 18; Rorona, Galley Reach, 2 ♂ ad., August 11; Boboli, China Straits, 1 ♀ ad., August 20; mainland opposite Samarai, 1 ♂ ad., 1 ♀ ad., September 18 and 28; Collingwood Bay, 1 ♀ ad., May 27; Kumusi River, 2 ♂ ad., 2 ♀ ad., 2 ♀ imm., May 30, July 3; Smbang, Huon Gulf, 2 ♀ ad., August 10; Fergusson Island, 2 ♂ ad., 1 ♂ imm., 1 ♀ imm., May 16, June 12; Kir.wina, Trobriand Island, 1 ♀ imm., May 16; Woodlark Island, 1 ♂ ad., April 26; St. Aignan, 2 ♂ ad., 1 ♀ ad., 1 ♀ imm., August 28, September 2; Sudest Island, 2 ♂ ad., 1 ♀ ad., 1 ♀ imm., May 4 and May 5.

The distribution of these 32 specimens over the months of the year are as follows: April 3, May 10, June 6, July 1, August 6 and September 6. Not a single specimen of the Australian race was collected between October and March. Every adult in May, June and July was molting, August and September birds are in fresh or slightly worn plumage. The wing measurements of adult birds are as follows: ♂ 88-93 (91.1), ♀ 90-96 (93.3).

The other twelve Papuan specimens must be regarded as belonging to *elisabeth*. The wing measurements of adult birds are as follows: ♂ 89, 91, 91, 91.5, 93, ♀ 88, 91, 92, 94, 97. The back is bluish, lacking the greenish tinge of Australian *macleayii*. The white bar across the wing is usually (but not always) much more pronounced, and starting on the third, instead of the fifth primary, the white edge along the inner edge of the primaries is on the contrary, much less conspicuous than in Australian specimens. I have examined the following material (arranged in a geographical sequence): 1 ♂ ad., Baroka, Bioto Creek, April 8; 1 ♀ imm., Aroa River, February 10; 1 ♂ ad., 2 ♀ ad., Rona (450 m.), Central division, March 8-17; 2 ♂ ad., 1 ♀ ad., Port Moresby, October 10-17; 1 ♂ ad., 1 ♂ imm., Annie Inlet, near East Cape, January 29; 2 ♀ ad., Konstantinhafen, Astrolabe Bay, November 15, and December 4. The majority of these specimens were collected during the breeding season of the Australian race. Plumage condition and molt are as follows: one November bird is very worn, one December, one January and one March bird are very worn and just beginning to molt; two March and one April bird are just completing their molt, and three October birds are fairly worn. The molt of the Astrolabe Bay birds is thus very much earlier, that of the Port Moresby district birds somewhat earlier than that of specimens of the Australian race.

All this is conclusive evidence that eastern New Guinea is inhabited by the endemic race *elisabeth* Heine. The fact that these birds nest in New Guinea is furthermore substantiated by the finding of their nests by Spalding (Proc. Linn. Soc. New South Wales, III, p. 261).

I am not able to study at the present time the differences between the various Australian populations. If the birds of southern Queensland and New South Wales are different from those from Northern Territory, they must be called *incincta* as Laubmann has shown (1924, Verh. Ornith. Ges. Bayern, XVI, p. 22). Cape York specimens average smaller than New South Wales birds, as I have shown above, and *barnardi* Campbell may have to be recognized, if different from typical *macleayii*.

I have not seen any material from the Aru Islands to determine whether or not *insularis* Berlepsch (1911, Abh. Senckenberg. Naturf. Ges., XXXIV, p. 75) is valid. The wing measurements he records for his specimens (80–85 mm.) are certainly smaller than even those of northwest Australian birds (85–91 mm.). He also characterizes this race as having the back bluish like *elisabeth* and as having the sides of the belly washed with rufous. This latter character, however, may be found in specimens of all the races, most rarely in *elisabeth*. Two specimens from the Key Islands (♂ ad. and ♀ imm., May 10) are rather greenish above and measure 86 and 91, they certainly do not show the supposed characters of *insularis*. Two adult males from Sermatta Island (June 14 and 17) are small (♂ 82, 86) and rather bluish above, but differ in this respect not materially from a series from the Northern Territory. They are probably migrants from northwest Australia, since I do not believe that the species nests on Sermatta Island.

Tanysiptera nympha Gray

Stresemann and Paludan (1936, Mitt. Zool. Mus. Berlin, XXI, p. 229) have already called attention to the fact that Laubmann's *rothschildiana* is not valid. From a study of the American Museum material and of the literature I get the following range of variation: western New Guinea, 89, 89, 89, 91, 91, 92, 94, 94.5, eastern New Guinea (Huon Gulf), 89, 92, 92, 92, 93, 96, 96, 96, 96, 96, 97, 97, 98, 98. These figures indicate that birds from the Huon Gulf average larger than such from the Vogelkop and Geelvink Bay, but also, that the overlap is too great to permit the recognition of any forms.

BUCEROTIDAE

Rhyticeros plicatus

In 1934 I named the race *dampieri* from New Britain based on the small size and slender bill (Amer. Mus. Novitates, No. 709, pp. 8–11). Discussing the New Guinea population, I deplored the lack of material from the western part of the Papuan Region and said: "Birds from the western Papuan Islands (including the type-locality, Waigeu) apparently agree in coloration with New Guinea birds, but there is a possibility of a size difference, in which case the New Guinea race would require a new name." At that time the Rothschild Collection was not yet available for study and I had to base my conclusion on the other collections of this Museum. Recently Dr. Junge of the Leiden Museum called my attention to the fact that birds in his collections from western New Guinea and the western Papuan Islands had very much

smaller measurements than those reported by me for north and east New Guinea birds. Following up this information I measured the entire material of the now available Rothschild Collection and found Dr. Junge's conclusions entirely confirmed.

Combining my own measurements and those communicated by Dr. Junge it is apparent that the Papuan Region is inhabited by a series of populations ranging over a wide variation of size. The smallest is found on Misol Island (fide Junge), the next larger on Waigeu (type-locality of *plicatus*) and Salawati, a still larger in northwest and in south New Guinea, a larger in the northern Moluccas, a larger in southeast New Guinea and the largest of all in north New Guinea between Japen Islands and Astrolabe Bay. There is much too much overlap to name everyone of these populations, but on the other hand it seems undesirable to lump them all under one name, particularly since there is a fairly regular increase in size from the southwest to the northeast (excepting the northern Moluccas). I therefore propose to name the population of north New Guinea and to include with it all birds from east New Guinea.

***Rhyticeros plicatus jungei*, new subspecies**

TYPE.—No. 267083, Amer. Mus. Nat. Hist., ♂ ad.; Madang, Astrolabe Bay, August 30, 1928; Rollo H. Beck.

Similar to *Rhyticeros plicatus ruficollis* (Vieillot), but much larger, particularly the bill.

Adult males (4-8 pleats on casque)			
<i>ruficollis</i>	WING	TAIL	BILL ¹
Waigeu	409, 418	230, 240	181, 187
Vogelkop	416, 418, 433, 440	238, 242, 253, 254	186, 189, 201, 209
Kapaur	432	251	202
<i>jungei</i>			
Jobi	431, 459	251, 266	207, 210
Takar-Hollandia	—	—	209
Astrolabe Bay	437, 443, 447 454	258, 260, 264 268, 269	210, 212 216, 224, 227
Southeast New Guinea	418, 438, 443, 444	244, 251, 254 257	198, 199, 210, 223
D'Entrecasteaux Archipelago	432, 447, 448	253, 260, 268	197, 221, 223
Aver. west New Guinea	423.7	244.0	193.6
Aver. east New Guinea	441.6	258.8	212.3

¹ Measured from the anterior edge of the nostril to the tip.

Adult females (4-6 pleats on casque)			
	Wing	Tail	Bill
<i>ruficollis</i>			
Waigeu	384, 385	208, 215	148, 155
Vogelkop	381	221	152, 152
<i>jungei</i>			
Takar-Hollandia		222	(139)
Astrolabe Bay	411, 414, 417	232, 234	164, 167, 175
Southeast New Guinea	392, 413	222, 222, 245	160, 161, 166
Aver. west New Guinea	383.3	214.7	151.8
Aver. east New Guinea	409.8	229.5	161.7

Further measurements on birds from west and south New Guinea will be found in a paper to be published shortly by Dr. Junge.

RANGE.—Eastern New Guinea, westward as far as Mamberano and Fly Rivers; Japen Island and D'Entrecasteaux Archipelago.

AMERICAN MUSEUM NOVITATES

Number 940

Published by
THE AMERICAN MUSEUM OF NATURAL HISTORY
New York City

August 18, 1937

ADDITIONS TO THE UPPER PALEOCENE FAUNA OF THE CRAZY MOUNTAIN FIELD

By GEORGE GAYLORD SIMPSON

In a previous paper (Simpson, 1936) an Upper Paleocene fauna from a high level in the Fort Union group east of the Crazy Mountains in central Montana was described. During the summer of 1936, Mr. Albert C. Silberling reopened the Scarritt Quarry, from which this fauna was derived, and made a second and still larger collection there for the American Museum. The present paper records the new data derived from this addition to the collection. A specimen from a still higher level at a nearby locality is also described. This specimen was collected by Mr. Silberling personally and was presented to the Museum, while the Scarritt Quarry collection was incidental to Museum expeditions under my direction. The specimens have all been prepared by Albert C. Thomson, and the illustrations are by John C. Germann.

The common forms in the Scarritt Quarry are now all represented by large suites of jaws and teeth, and most of the specimens found by the last collecting added little or nothing to knowledge of the fauna. There are still several rare forms on which our data are very inadequate, but the chances of obtaining better specimens of these by any reasonable amount of quarrying have become small. No further work in the quarry is planned for the near future, and this paper is essentially a final report on the fauna.

FAUNAL LIST OF THE SCARRITT QUARRY

The following list includes all the specimens now in hand, those already listed (Simpson, 1936) as well as the new material.

	NUMBER OF SPECIMENS			
	Jaws			Isolated
	Upper	Lower	Both	Teeth
MULTITUBERCULATA				
Ptilodontidae				
<i>Ectypodus hunteri</i>	3	10		44
Gen. et sp. indet.				2

	NUMBER OF SPECIMENS			
	Jaws			Isolated
	Upper	Lower	Both	Teeth
INSECTIVORA				
Leptictidae				
<i>Leptacodon cf. tener</i>		6		
Pantolestidae				
<i>Bessoecetor thomsoni</i>	5	21	1	3
<i>Palaeosinopa senior</i>				3
Mixodectidae				
<i>Elpidophorus patratu</i> s	1	4	1	6
Incertae Sedis				
<i>Unuchinia</i> ¹ <i>asaphes</i>		1		
PRIMATES				
Plesiadapidae				
<i>Plesiadapis anceps</i>		1	1	8
Carpolestidae				
<i>Carpodaptes hazelae</i>	3	6	1	1
Incertae sedis				
<i>Phenacolemur frugivorus</i>		3		
CONDYLARTHRA				
Hyopsodontidae				
<i>Litolestes notissimus</i>	5	50	1	5
CONDYLARTHRA or CREODONTA indet.				9
PANTODONTA				
Pantolambdidae				
Gen. et sp. indet.				2
TOTALS	17	102	5	83
TOTAL JAWS		124		
GRAND TOTAL			207	

The percentages of identified specimens of the common species are as follows:

<i>Ectypodus hunteri</i>	28%
<i>Bessoecetor thomsoni</i>	14%
<i>Elpidophorus pat ratus</i>	6%
<i>Plesiadapis anceps</i>	5%
<i>Carpodaptes hazelae</i>	5%
<i>Litolestes notissimus</i>	29%
All others	13%

¹ The name *Apator*, previously applied to this genus, was found to be preoccupied and replaced by *Unuchinia* (Simpson, 1937).

If only the better specimens, jaws, are taken into consideration, *Litolestes notissimus* forms nearly half of the collection and altogether the three most common species, out of the thirteen or probably more present, account for nearly three-fourths of the specimens, but the quarry is mixed and apparently gives a fair sample of a whole faunule, although one of very limited facies.

Except for the last species, *Titanoides zeuxis*, all the material described below is from the Scarritt Quarry.

Ectypodus hunteri Simpson, 1936

The large new sample of this species includes good specimens, but has no parts not already known. The material of P_4 has approximately the same range as the adequate sample already reported. Two new jaws have M_1 , the cusp formulae being $9? : 4$ and $8 : 4$, and there is an isolated M^1 measuring 3.1 by 1.4 mm. and with the cusp formula $8 : 11 : 8$. The differences from *E. musculus* in these teeth are thus confirmed and may be taken as established.

Ptilodontid Indet.

An isolated ptilodontid M_2 measures 3.0 by 2.6 mm., by a coincidence exactly twice both linear dimensions of the type of *Ectypodus hunteri*. This doubtless belongs to the ptilodontid previously reported from an isolated M^1 , likewise twice the size of those referred to *E. hunteri*. The material is still inadequate to define this apparently new multi-tuberculate.

Leptacodon cf. *tener* Matthew and Granger, 1921

There are now six jaws in the collection that represent small insectivores allied to *Leptacodon tener*. They differ considerably among themselves in size, in the development of the metaconid on P_4 , and in the elevation of the trigonids. Quite possibly more than one species is represented, but the fragmentary specimens do not make this sufficiently clear. The Tiffany specimens of *L. tener* are within the variation of these Scarritt Quarry specimens and further make it impossible to separate the latter from each other or from *L. tener* on any justifiable basis.

Bessoecetor thomsoni Simpson, 1936

This species is well represented in the new material, but no additions to the morphology are made. Two good upper jaws confirm the correctness of the composite illustration previously given. The abundant

material now in hand gives the following data on dimensions of lower teeth:

	N	R	M	σ	V
LP ₃	8	1.7 - 2.0	1.81 \pm .04	.12 \pm .03	6.5 \pm 1.6
WP ₃	8	.8 - 1.0	.888 \pm .021	.060 \pm .015	6.7 \pm 1.7
LP ₄	13	2.1 - 2.8	2.49 \pm .04	.16 \pm .03	6.3 \pm 1.2
WP ₄	11	1.0 - 1.3	1.19 \pm .03	.100 \pm .021	8.4 \pm 1.8
LM ₁	12	2.0 - 2.5	2.19 \pm .04	.14 \pm .03	6.3 \pm 1.3
WM ₁	13	1.4 - 1.9	1.59 \pm .04	.14 \pm .03	8.7 \pm 1.7
LM ₂	16	2.0 - 2.4	2.19 \pm .03	.117 \pm .021	5.3 \pm .9
WM ₂	16	1.6 - 2.0	1.78 \pm .03	.109 \pm .019	6.1 \pm 1.1
LM ₃	16	2.3 - 2.8	2.56 \pm .03	.127 \pm .023	5.0 \pm .9
WM ₃	14	1.6 - 2.0	1.79 \pm .03	.106 \pm .020	5.9 \pm 1.1

Palaeosinopa senior, new species

TYPE.—AMERICAN Museum No. 33990, right M₁.

HORIZON AND LOCALITY.—Upper Paleocene, Scarritt Quarry, Crazy Mountain Field, Montana.

DIAGNOSIS.—Trigonid of M₃ strongly elevated; talonid small and narrow; entoconid distinct and at least as high as the hypoconid. Dimensions of type 5.2 by 3.4 mm.

The presence of a form allied or belonging to *Palaeosinopa* was recognized from a single upper molar in the first collection from this quarry. It is still represented only by isolated teeth, but these are now three in number, are definitely indentifiable, and are of considerable distributional interest. The lower molar selected as the type is intermediate in size between *P. veterrima* and *P. didelphoides* and might be within the size range of either. As would be expected, it is structurally more like the older of these Lower Eocene species, *P. veterrima*, but has a considerably higher trigonid and other minor distinctions.

American Museum No. 33991 is a right upper molar, probably M¹ of this species. It measures 4.7 by 6.0 mm. and differs from M¹ of *P. veterrima* in that the hypocone, although not greater in bulk, projects more strongly internally. American Museum No. 33828, measuring 5.0 by 8.0 mm., is likewise a right upper molar, perhaps M² of this species. Like the tooth just described, it has a small but strongly internal hypocone and otherwise closely resembles the corresponding tooth of *P. veterrima*.



A.M. 33990 Type

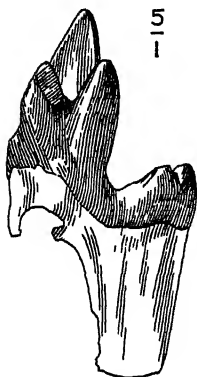
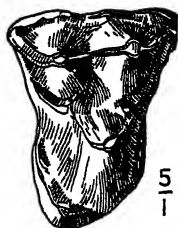


Fig. 1



A.M. 33991

Fig. 2

Fig. 1.—*Palaeosinopa senior*, new species. Type, Amer. Mus. No. 33990, right M_4 . Crown and internal views. Five times natural size.

Fig. 2.—*Palaeosinopa senior*, new species. Amer. Mus. No. 33991, right upper molar. Crown view. Five times natural size.

Plesiadapis anceps Simpson, 1936

A lower jaw, American Museum No. 33978, in the new collection has P_3 which closely resembles that of *P. gidleyi*, and has traces of alveoli which seem to indicate that P_2 was present as in *P. gidleyi* and unlike other known species of the genus. An isolated incisor, American Museum No. 33976, must belong to this species, but unlike the type it has the basal lingual cuspule as well developed as in *P. gidleyi*, so that the small size of this cuspule evidently was not a constant character of the species.

Carpodaptes hazelae Simpson, 1936

A new specimen of this species, American Museum No. 33980, consists of associated left upper and lower jaws with the upper ?canine, P^2-M^3 , and P_4-M_3 . This splendid specimen is of particular interest for revealing, for the first time, the whole upper cheek dentition in this family, one of the most peculiar known. An isolated posterior upper premolar of the closely allied genus *Carpolestes* was discovered at

Bear Creek and in the absence of other indications I at first placed it among the Multituberculata (Simpson, 1929). Jepsen (1930) later found in northern Wyoming an upper jaw of *Carpolestes* with P^3-M^2 and corrected my serious mistake. The last premolars remarkably resemble those of some multituberculates, but this resemblance is entirely convergent, the molars and the dentition as a whole being very different from any multituberculates and prohibiting any thought of real relationship. P^3-4 of the present species were described in the first paper on this fauna, but the more anterior upper teeth and M^3 have not hitherto been known in any carpolestid.

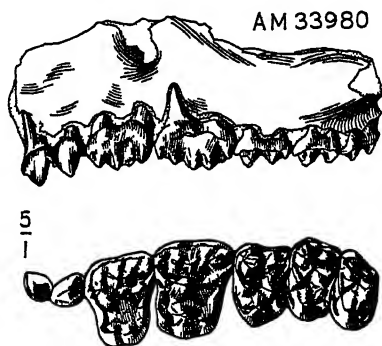


Fig. 3.—*Carpodectes hazelae* Simpson. Amer. Mus. No. 33980, left upper jaw with C-M³. External and crown views. Five times natural size.

The upper jaw as preserved probably ends anteriorly at the premaxillary suture, but this is not certain. The first two teeth are minute and are closely crowded. They might be either the canine and P^2 with P^1 missing, or P^1-2 with the canine probably but not surely missing. From the mode of reduction in analogous and probably allied forms such as *Plesiadapis*, it seems slightly more probable that P^1 has been lost. The first tooth has a somewhat proclivous, crested, but not markedly compressed outer cusp, preceded and followed by small cuspules of which the posterior is at a higher level (more basal on the crown). There is a strong, continuous, internal cingulum and the tooth is slightly expanded posterorinternally so as to be oval, or vaguely triangular, in plan. The following tooth, which must be P^2 in any case, is similar but is slightly larger, the main cusp is more symmetrical, the cuspules or styles are nearly at the same level, and the plan is less oblique.

P^3-4 are abruptly and profoundly different from the preceding teeth

in size and in structure. They are nearly unworn and beautifully preserved on this specimen and give details obscure on that previously described. P^3 has four large outer cusps, the second largest and the posterior three more closely related to each other than to the first. A narrow but sharp and continuous external cingulum passes around the base of the anteroexternal cusp and is continuous with the anterior cingulum. Posteriorly the external cingulum merges with the posteroexternal cusp without forming a distinct cuspule. A crest departing from the posterior end of the posteroexternal cusp forms a crescent internal to the outer cusps and ends anteriorly in a strong cusp internal to the notch between the first and second outer cusps. Posterior to this the sharp crest is irregular but has no definite cuspules. The internal lobe has a strong anterointernal cusp, preceded by a very vague and feeble cuspule and followed by a strong crest which tends to form a large but poorly distinguished posterointernal cusp.

On P^4 , in addition to four cusps that closely resemble the external cusps on P^3 , there are small but distinct anteroexternal and posteroexternal cuspules, both seeming to be developed from the ends of the cingulum. The intermediate crescent has its main cusps in a medial position, preceded by a small cuspule and followed by a sharp crest not developing a definite cusp. On the internal crescent, also, the main cusp is medial and it is preceded and followed by smaller but distinct, subequal cusps.

The more obvious distinctions of P^{3-4} from those of *Carpolestes dubius*, as described by Jepsen (1930) are the more symmetrical plan of P^3 , more transverse P^4 , the presence of only four (as opposed to five) external cusps on P^3 , and the presence of only one definite cusp, not two, on the intermediate crescent of that tooth. P^3 of *Carpolestes nigridens*, described by me (1929) as *Litotherium complicatum*, differs still more from that of the present specimen, being less transverse, with an anteroexternal projection more pronounced than in *Carpolestes dubius*, and also with five outer cusps.

M^{1-2} have subequal paracone, metacone, and protocone, well developed subequal conules, sharp and continuous external, anterior, and posterior cingula, and small hypocones which terminate the posterior cingulum at the inner end and are also connected, less strongly, to the protocone tip by a ridge. M^3 is not much reduced in size but, as usual, has its posterior parts reduced relative to the anterior.

The seven lower jaws now available do not support the supposed distinction from *C. aulacodon* of greater anteroposterior compression of

M₁₋₂, but do confirm the other morphological distinctions and show them to be constant or nearly so, notably the more quadrate P₄ with five sharply distinct cuspules and less pointed apex and the more distinct third lobe of M₃. There is no size difference between the two species.

Carpolestes and *Carpodaptes* are closely allied genera, nearer each other than genera often are in paleontology, yet the several species now known still fall readily and naturally into two definable groups and it is convenient to call these genera. There are many minor distinctions constant in association as far as known, but the most obvious point of contrast is that in *Carpolestes* P₄ is relatively enlarged, has more apical cuspules, and its posterior cuspule has been elevated to the paraconid level of M₁ and has lost the definite talonid character retained in *Carpodaptes*. In this and all the other apparently distinctive characters, *Carpolestes* seems to be the more specialized genus.

In spite of the extraordinary specialization of the premolars, the facts now known about the carpolestid dentition all seem to me to point to the early primates and to no other group. The most primitive species of *Plesiadapis* have all the basic structures of the carpolestid dentition, and the aberrant specialization of the latter puts these animals on a distinct line of descent, obviously, but does not hide a resemblance so close fundamentally that I cannot conceive any other explanation for it than close relationship and community of origin.

The sample is too small to give good data on numerical variation, but the following figures give some conception of this:

	N	R	M
LP ₄	4	2.3 - 2.7	2.50
WP ₄	4	1.8 - 1.9	1.88
LM ₁	7	1.4 - 1.6	1.51
WM ₁	7	1.4 - 1.7	1.50
LM ₂	7	1.2 - 1.4	1.30
WM ₂	7	1.4 - 1.6	1.54
LM ₃	4	1.9	1.90
WM ₃	4	1.2 - 1.4	1.33

The upper teeth of American Museum No. 33980 have the following dimensions:

?C		P ²		P ³		P ⁴		M ¹		M ²		M ³	
L	W	L	W	L	W	L	W	L	W	L	W	L	W
0.9	0.6	1.0	0.8	1.9	2.4	2.0	2.6	1.3	2.3	1.3	2.2	1.2	2.0

***Phenacolemur frugivorus* (Matthew and Granger, 1921)**

Two new lower jaws of this species add little to knowledge of it, but it is worthy of note that this increased evidence still gives no suggestion that the Fort Union specimens differ from those of the Tiffany.

Measurements of the three Scarritt Quarry specimens are as follows:

	P_4		M_1		M_2	
	L	W	L	W	L	W
33988			2 0	1 4	2 0	1 6
33987	1.4	1.1	1.8	1 5	2.0	1.7
33896	1.6	1.1	1.9	1.4	1 8	1 5

***Litolestes notissimus* Simpson, 1936**

This common species is now represented by a remarkably large series of good specimens. American Museum No. 33940 preserves the crown of an incisor, probably I_2 . It has a long posterolingual heel, not definitely cuspidate. The main apex is recurved and spatulate and posterolabial to it is a distinct accessory cusp. American Museum No. 33941 has the canine, which is enlarged and has a long curving root and shorter curving crown with a feeble and non-cuspidate posterolingual heel but no trace of the second cusp seen on the incisor. The upper incisors and P_1 are still unknown and the other parts of the dentition were described previously.

Among these specimens there are many minor morphological variations, and the whole series is worthy of minute study. At present only two interesting points will be mentioned. On P_4 , a metaconid is always present, but it varies from a small swelling on the protoconid to a sharp, distinct cusp. The intermediate condition is most frequent and the character seems to be a continuous variate distributed normally, although it can hardly be reduced to numerical values. Another markedly variable character is the external cingula of P_4 - M_3 . Data on this have some subjectivity, as the variation is apparently continuous but hardly measurable as such, while probably no two observers would agree exactly as to when the cingulum can be said to be present and when absent. Yet the data are comparable when gathered by one student. I have counted the cingulum as present (or well developed) when it is distinctly visible around the external base of the trigonid, and otherwise as absent or poorly developed, and on this basis present the following data.

TOOTH	NUMBER OF OBSERVATIONS	CINGULUM DISTINCT		
P ₄	24	2	8	%
M ₁	35	11	31	%
M ₂	36	8	22	%
M ₃	24	3	12 ¹ / ₂	%

The following data are derived only from specimens in which observations were made on both M₁ and M₂ of the same side of the same individual:

Well developed on both M ₁ and M ₂	6	20%
Only on M ₁	3	10%
Only on M ₂	1	3%
On neither.....	20	67%

And the following data similarly apply to associated M₁₋₃:

Well developed on all.....	1	6%
On M ₁₋₂ but not M ₃	2	11%
On M ₁ only.....	3	17%
On M ₂ only.....	1	6%
On none.....	11	61%

From these data it follows that the cingulum is most often well developed on M₁ and least often on M₃, among the molars. It may be well developed on any one, or probably any two, of the teeth without being so on the others but nevertheless there is a significant tendency for its development on M₂ or M₃ to be associated with similar development on the more anterior molars, M₁ or M₁₋₂, respectively. These observations are not of outstanding interest as regards *Litolestes*, particularly, but the accumulation of such data is very important for an understanding of paleontological procedures and of evolution.

The following data are now available for the dimensions of the lower cheek teeth¹:

	N	R	M	σ	V
LP ₁	7	1.0 - 1.3	1.17 \pm .05	.13 \pm .03	10.9 \pm 2.9
WP ₂	6	.6 - .8	.68 \pm .03	.069 \pm .020	10.1 \pm 2.9
LP ₃	14	1.3 - 1.8	1.57 \pm .04	.14 \pm .03	8.8 \pm 1.7
WP ₃	13	.9 - 1.2	1.031 \pm .023	.082 \pm .016	8.0 \pm 1.6
LP ₄	32	1.8 - 2.4	2.138 \pm .025	.141 \pm .018	6.6 \pm .8

¹ As elsewhere in this paper (and all others by me) standard errors are given and each constant is generally recorded to the number of places indicated by the first significant figure of one-third of the standard error. In the present case the raw data would have been better if it could have been recorded to .01 mm., which was impracticable. At least the first two decimal places of the constants, however, are probably little affected by this deficiency, although it may have influenced the high values for V in the first two variates, but these also have large standard errors.

	N	R	M	σ	V
WP ₄	32	1.2 - 1.6	1.406 \pm .018	.100 \pm .012	7.1 \pm .9
LM ₁	42	1.8 - 2.2	1.960 \pm .015	.100 \pm .011	5.1 \pm .6
WM ₁	41	1.5 - 1.8	1.610 \pm .016	.105 \pm .012	6.5 \pm .7
LM ₂	39	1.5 - 1.9	1.672 \pm .015	.093 \pm .011	5.6 \pm .6
WM ₂	39	1.4 - 1.7	1.549 \pm .014	.087 \pm .010	5.6 \pm .6
LM ₃	27	1.5 - 1.9	1.681 \pm .022	.116 \pm .016	6.9 \pm .9
WM ₃	24	1.2 - 1.4	1.283 \pm .011	.055 \pm .008	4.3 \pm .6

Phenacodont or Arctocytonid, Indet.

Nine isolated teeth, upper and lower, all of about the same size and of similar character, present a difficult taxonomic problem on which it seems best not to attempt a definite commitment until the discovery of associated material reduces the present probability of falling into serious error. Two upper molars and upper and lower probable milk teeth closely resemble *Tetraclaenodon*, but not to the point of specific identity with any specimens surely referred to that genus and not without also having much resemblance to condylarth-like arctocytonids such as *Tricentes*. Similarly an upper premolar, a broken upper molar, and three lower molars resemble *Tricentes* or similar arctocytonids, yet are not structurally referable to any previously known form and also have a more distant but still definite resemblance to the phenacodonts. There would seem to be considerable chance that these teeth belong to one species in view of their size, structure, relative abundance, and occurrence together. If so they would represent a new and peculiar genus, which is quite possible. On the other hand, they could equally well represent two or more different forms among the phenacodonts and arctocytonids. If they were considered singly, some would be referred to *Tetraclaenodon*, some to a doubtful arctocytonid, and some would be left indeterminate, but the whole series casts doubt on even a vague determination of any of them.

Titanoides zeuxis, new species

TYPE.—American Museum No. 35201, left lower jaw with P₃, trigonids of M₁₋₂, M₃, and other fragments.

HORIZON AND LOCALITY.—About 1000 feet stratigraphically above the Scarritt Quarry, "No. 3 beds" of the Fort Union Group, Section 26, Range 14 East, Township 5 North, Sweetgrass County, Montana.

DIAGNOSIS.—Much smaller than *T. primaevus* and slightly smaller than *T. gidleyi*. Lower cheek teeth more or less intermediate between these species and *Paniolambda*, with the trigonid little compressed but paraconid much lower than metaconid on M₁ and somewhat lower on M₂, trigonids moderately elevated above

talonids, M_3 with heel relatively large, hypoconulid and entoconid distinct and sub-equal, division of third lobe vaguely retained.

The specimen on which this interesting species is based was found on the surface and broken into many pieces, with few positive contacts. There seems to be no doubt that all are of one individual, since they were found together, without admixture of any certainly distinct material, the recognizable fragments without duplication, all of the left lower

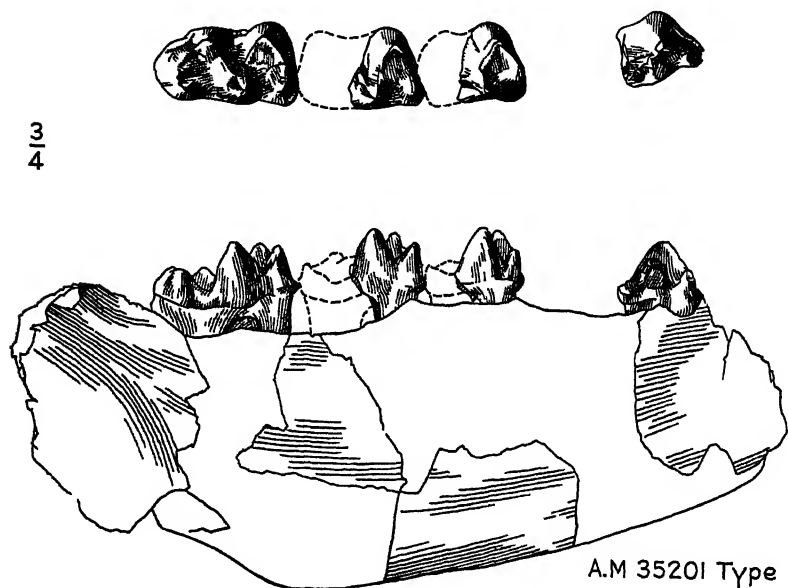


Fig. 4.—*Titanoides zeuxis*, new species. Type, Amer. Mus. No. 35201, left lower jaw with P_3 , M_3 , and trigonids of M_{1-2} . Crown and internal views. $3/4$ natural size.

jaw, and all of an animal of the same size and character and one otherwise unknown. There is one nearly complete premolar in a jaw fragment that might possibly be P_4 , but from the shape of the bone and the morphology of P_{3-4} in related species it is almost surely P_3 . A broken isolated tooth might be P_4 but there are difficulties in fitting it into this position and it seems best to disregard it. The trigonids of M_1 and M_2 are well preserved and there can be little question of their correct identification. M_3 is complete.

P_3 has the trigonid of nearly equal length and width. The paraconid

is very small, but is a distinct cusp. There is an inconspicuous cingular shelf below it on the internal face. The metaconid is broken but was evidently large. The talonid is very small and internal, in form like that of *Pantolambda* or *Titanoides primaevus*. There is a well developed posterior cingulum external to the talonid, proper, and also a much feebler but sharp anterior cingulum. There was probably a still weaker external cingulum, but this is uncertain as the tooth is corroded here.

The molar trigonids are wider than long, but are less compressed anteroposteriorly than is usual in *Pantolambda*. All have upstanding metaconids at least as high as the protoconid and broadly separated from the paraconids. On M_1 the paraconid is low and inconspicuous, on M_3 it approaches the metaconid in prominence, and on M_2 it is intermediate. On all three there is a basal swelling below the paraconid on the internal face and a strong anterior cingulum. There are no distinct metastylids, but a fold or crest in this position is well developed. The elevation of trigonids above talonids seems to be slightly greater than is usual in *Titanoides* and less than in most specimens of *Pantolambda*. The talonid of M_3 slightly exceeds the trigonid in length but is narrower. The talonid basin is open on the internal side and there seems to have been no marked proliferation of cusps in this region. The entoconid and hypoconulid form a united crest, yet they have distinct apices equal in size and in height. There is a distinct emargination between hypoconid and hypoconulid and here there is a strong oblique cingulum.

On comparison of original specimens of the lower cheek teeth of *Pantolambda bathmodon*, *P. cavirostris*, *P. intermedius*, *Titanoides primaevus*, and *Barylambda faberi* and of Jepsen's figures of *Titanoides gidleyi*, all the valid species with which the present specimen is comparable, any sharp distinction between *Pantolambda* and *Titanoides* seems to disappear. As Patterson (1933) considered possible, the characters of *Titanoides* (including the form recently made type of *Barylambda*; Patterson, 1937) given by him as distinctive from *Pantolambda* in this region almost all intergrade when the whole known series is compared and there is no definite line. As tendencies rather than as hard and fast rules, the molar trigonids of *Titanoides* may be relatively lower and less compressed anteroposteriorly and the talonid of M_3 tends to be shorter, more rounded, with the internal cusps less individualized. In all these characters, and most others, the present specimen is about intermediate between *Pantolambda* and *Titanoides*. As between *Pantolambda* and *Barylambda* it is decidedly closer to *Pantolambda*, but on the whole it resembles *Titanoides primaevus* more than it does any recognized species

of *Pantolambda*. As *T. primaevus* is the genotype, reference to *Titanoides* thus seems preferable, but this new species practically obliterates what few diagnostic characters might still have been used to separate the genera on the basis of these teeth.

I differ from Patterson's first opinion in believing that the *Titanoides* and *Barylambda* dentitions, as a whole, are more specialized than that of *Pantolambda*. As far as the lower cheek dentition is concerned, *Pantolambda bathmodon* - *Titanoides zeuxis* - *Titanoides primaevus* - *Barylambda faberi* seem to me to form an ascending structural series. There probably are exceptions in details of structure, such as the compression of the trigonid in *Pantolambda*, which may be specialized but still is not a very pronounced distinction. Patterson has, however, demonstrated that this close structural relationship, which he also emphasizes, can hardly reflect direct phylogenetic connection between known species of *Pantolambda* and *Barylambda*.

There is no doubt that *Titanoides* belongs to the family Pantolambdidae, but its subfamily reference is very uncertain. Patterson (1934) divided the family into Pantolambdinae and Titanoidinae, but the division was based on skeletal characters observed in *Titanoides faberi* and not in the genotype. In removing *T. faberi* from *Titanoides* to a new genus, *Barylambda*, Patterson (1937) has necessarily deleted the subfamily Titanoidinae, since the characters assigned to that group are not in fact known in *Titanoides*, and substituted Barylambdinae. He now refers *Titanoides (sensu stricto)* to that subfamily, but strongly emphasizes the tentative nature of the reference. It cannot be determined until skeletal material of *Titanoides* is found. With equal emphasis on the dubiousness of any reference at present, I would very tentatively place *Titanoides* in the Pantolambdinae. The skeleton, when discovered, may very well completely negative the dental evidence, but in parts actually known now *Titanoides* seems to me somewhat closer to *Pantolambda* than to *Barylambda*.

The dimensions of the type teeth of *Titanoides zeuxis* are as follows:

P ₃		M ₁	M ₂	M ₃	
L	W	W ¹	W ¹	L	W
14.7	12.6	13.7	14.0	25.1	14.2

¹ These are across the trigonid, the talonid being missing, but doubtless on both these teeth the trigonid width was greater and would be recorded as the tooth width even on complete teeth.

REFERENCES

- JEPSEN, G. L. 1930. 'Stratigraphy and paleontology of the Paleocene of north-eastern Park County, Wyoming.' *Proc. Amer. Phil. Soc.*, LXIX, pp. 463-528.
- PATTERSON, B. 1933. 'A new species of the amblypod *Titanoides* from Western Colorado.' *Amer. Jour. Sci.*, XXV, pp. 415-425.
1934. 'A contribution to the osteology of *Titanoides* and the relationships of the Amblypoda.' *Proc. Amer. Phil. Soc.*, LXXIII, pp. 71-101.
1937. 'A new genus, *Barylambda*, for *Titanoides faberi*, Paleocene Amblypod.' *Geol. Ser. Field Mus. Nat. Hist.*, VI, pp. 229-231.
- SIMPSON, G. G. 1929. 'Third contribution to the Fort Union fauna at Bear Creek, Montana.' *Amer. Mus. Novitates*, No. 345, pp. 1-12.
1936. 'A new fauna from the Fort Union of Montana.' *Amer. Mus. Novitates*, No. 873, pp. 1-27.
1937. '*Unuchinia*, new name for *Aptator* Simpson, not Semenow.' *Journ. Paleont.*, XI, p. 78.

AMERICAN MUSEUM NOVITATES

Number 941

Published by
THE AMERICAN MUSEUM OF NATURAL HISTORY
New York City

August 18, 1937

NEW SOUTH AMERICAN SYRPHIDAE (DIPTERA)

By C. L. FLUKE, JR.

The following new species, with the exception of two, are from Nova Teutonia (27° 11' Lat., 52° 23' Long.) in southern Brazil and were collected by Fritz Plaumann. The other two were taken, one in Ecuador, and one in Peru. The types are deposited in The American Museum of Natural History. Paratypes, where available, are deposited in the author's collection. Considerable aid has been given freely by Dr. C. H. Curran in identification of the many specimens received from South America and other localities, and I wish to thank him for his help.

TRICHOPSOMYIA WILLISTON

WILLISTON, S. W. 1888, Trans. Amer. Ent. Soc., XV, p. 259.

Halictomyia, SHANNON, R. C. 1927, Proc. U. S. Nat. Mus., LXX, Art. 9, p. 13.

Small, mostly shining black species with irregularly pilose eyes; antennae elongate; legs long pilose, the hind femora and tibiae inflated, the basal joints of the four front tarsi whitish in color.

This is an interesting genus which has been well characterized by Williston. Shannon has described a species from Bolivia which appears to be related to *polita* Williston. I am indebted to Dr. C. H. Curran for aid in the preparation of the following key. Shannon's species was not available so is not included.

TABLE OF SPECIES

- 1.—Second abdominal segment with a pair of oblique yellow spots. . . *currani*, n. sp.
Abdomen without yellow spots. 2.
- 2.—Pile of eyes divided into upper and lower patches by a transverse bare stripe. . 3.
Eyes irregularly pilose, sometimes with five or six patches. 5.
- 3.—Tibiae never in part clear yellow, antennae much longer than the face.
longicornis Williston.
Anterior four tibiae very broadly yellow basally; antennae not, or only a little,
longer than the face. 4.
- 4.—Scutellum pale pilose, at most a few marginal hairs black. *polita* Williston.
Scutellum mostly black pilose. *lasiotibialis*, n. sp.
- 5.—Pile of eyes with a continuous horizontal bare stripe across the middle; scutellum
of female nearly entirely black pilose. *granditibialis*, n. sp.

- Transverse bare median stripe interrupted inwardly by a vertical band or spot of dense pile. 6.
- 6.—Inner band of pile on the eyes continuous; female without large tubercles on the front. *puella* Williston.
- Inner band broken up into three spots; front of female with a large, prominent tubercle on each side above. *tuberculata* Williston.

Trichopsomyia currani, new species

Figure 1

Characterized readily by the presence of a pair of oblique yellow spots on the second tergite. Length, 8 mm.

FEMALE.—Head entirely shining blue-black, pile of face and front yellow and peculiarly flattened or curled, a few scattered black hairs on the front, more just in front of the posterior ocelli, ocular edges of the face very narrowly silvery pollinose, this streak broadens out below onto the face and is very narrowly interrupted opposite the antennae; in addition there is a small triangular spot on each side of the front about halfway between the antennae and ocelli. Facial tubercle inconspicuous. Occiput swollen and shining above, covered with silvery pollen below; occipital pile yellow. Antennae as long as the face, brownish in color with indefinite light brown color toward the bases of the segments; arista as long as third segment, yellow at the base, black at tip. Eyes heavily covered with brownish to black hair with a nearly bare horizontal stripe about the middle; this stripe is broadest at the middle and contains a few scattered hairs; along the occipital margin the hairs are also mostly absent, those present being shorter.

Thorax shining, the mesonotum and scutellum with a bronze cast; the pile short and yellowish brown, a few longer black hairs on the edges of the scutellum.

Legs shining black, front four femora reddish at the tips, the tibiae yellowish to reddish, darker at the middle, the basal two segments of the tarsi whitish; hind legs very narrowly reddish at the knees, the basitarsi at the apex and the next two segments white. Pile of the legs long, pale, and ciliate, black on the apex of the posterior tibiae and base of the posterior basitarsi; hind femora inflated, hind tibiae very little swollen.

Wings hyaline, the stigma yellowish to brownish. Squamae light brown, halteres yellow, plumule white.

Abdomen shining aeneous with a pair of conspicuous oblique yellow spots on the second tergite, posterior margins of the second and third tergites opaque; pile inconspicuous, pale in color.

TYPES.—Holotype, female, Nova Teutonia, Brazil, Nov. 21, 1936 (Fritz Plau-mann). Paratypes: three females same place, Oct. 20, Nov. 14, and Nov. 21, 1936.

Trichopsomyia lasiotibialis, new species

Figures 2 and 3

An elongate species, antennae shorter than the face, pile of the mesonotum golden, of the scutellum mostly black. Length, 6 and 10 mm.

MALE.—Face shining with yellowish bent pile, a few black hairs near the eyes and on the cheeks next to the oral margin. Front shining with a large triangular opaque brownish black pollinose area on the upper third, the pile black with the

center hairs yellowish and bent. Ocellar hairs black and there is a very small opaque spot just posterior to the anterior ocellus. Occipital pile immediately adjacent to the ocellar triangle yellowish but black on the sides about a third of the way down. Antennae shorter than the face; brownish, more yellowish at the bases of the segments; basal half of arista yellowish. Eyes hairy with the bare stripe uninterrupted, the eyes behind and above also bare.

Thorax black, the mesonotum with a bronze pollinose cast, the pile rather long and golden, black anteriorly, especially near the humeri; pile on the upper pteropleura and mesopleura black. Scutellum semi-opaque black, shining at the tip; pile black, a few yellow hairs intermixed. Disc of scutellum with a shallow, almost circular depression.

Legs very similar to *currani* in color; the hind femora slightly club-shaped, being more inflated toward the tip than toward the base; the tibiae more slender than the femora. Pile of the femora mostly black, white at the base of the hind femora.

Wings hyaline, darker across the middle, especially near the stigma which is brownish. Squamae and halteres blackish, the plumule light brown.

Abdomen semi-opaque black with shining bronze side spots on the third and fourth tergites, the second tergite has a bluish cast in certain lights. The pile is golden with shorter black hairs at the apices of the tergites.

Types.—Holotype, male, Nova Teutonia, Brazil, Nov. 13, 1936 (Fritz Plau-mann); paratype, male, same place, Feb. 25, 1937.

I have hesitated to describe this species as new but have been unable to connect it with any of the described species. It appears nearest to *currani* but lacks the yellow spots on the abdomen, and the eye patches are different. It does not seem to be any of the species in which the males are known.

Trichopsomyia granditibialis, new species

Figures 4 and 5

A dark oval species; pile of the eyes patchy, the transverse stripe continuous; antennae longer than the face; scutellar and mesonotal pile mostly black; tibiae black; wings brown basally. Length, 9 mm.

FEMALE.—Head shining black. Face with whitish bent pile, the median line bare of hairs; the silvery pollinose stripes along the eyes similar to *currani*; pile next to the oral margin on the cheeks black in some specimens. Front smooth, depressed slightly at the side dust spots, pile white and bent in the middle; longer, straight, and black along the sides and around the ocellar triangle which is very prominent. The occipit is bare of pollen above, whitish pollinose below, the pile all yellowish. Eyes with an uninterrupted bare transverse stripe, in addition there is a bare stripe leading up from the transverse area and a bare patch below. Antennae longer than the face, first segment twice as long as the second; arista black, yellow on the basal fourth.

Thorax shining black, the pile black with white hairs intermixed on the anterior third of the mesonotum and a few in front of the scutellum, a rather prominent patch of white hairs on the mesopleura and partly on the upper sternopleura; most of the pile of the scutellum is black but a few white hairs are occasionally present along the sides and basally.

Legs shining black, the knees only briefly reddish, tarsal segments whitish as in *currani*; pile long and all black except on the white areas. The hind tibiae dilated, much larger than the femora.

Wings dark brown basally, especially near the stigma, more hyaline apically. Squamae brownish, plumule light brown, halteres yellowish with whitish knobs.

Abdomen shining dark reddish, the discs of the segments darker than the sides. The pile is short, mostly golden basally and along the sides, other areas black.

MALE.—Frontal triangle with the characteristic opaque spot in the orbital corner. Mesonotum with a broad, median, semiopaque, crossband. Abdomen black, mostly shining, partly opaque on the disc of the second and third tergites.

TYPES.—Holotype, female, Nova Teutonia, Brazil, Oct. 25, 1936 (Fritz Plau-mann); allotype, male, same place, Feb. 19, 1937. Paratypes: two females, same data as the holotype.

This is the largest *Trichopsomyia* described and is broader than the other known species. It is closest to *puella* Williston but can be told from that species by its dark reddish abdomen (female) and continuous uninterrupted bare stripe of the eyes.

Epistrophe biarcuata, new species

Figure 6

Disc of the abdomen opaque black, with five arcuated transverse bands, the first, second and fourth interrupted into spots. Wings brownish. Length, 9 to 11 mm.

Captions for Figs. 1 to 15

All of the drawings except figure 7 were made with the aid of the camera lucida, but they are not all drawn to the same scale.

Fig. 1. *Trichopsomyia currani*, n. sp., abdominal pattern of female.

Fig. 2. *Trichopsomyia lasiotibialis*, n. sp., profile of head of male to show bare spots on the eye.

Fig. 3. *Trichopsomyia lasiotibialis*, n. sp., inner view of antenna.

Fig. 4. *Trichopsomyia granditibialis*, n. sp., femora and tibia of hind leg of female.

Fig. 5. *Trichopsomyia granditibialis*, n. sp., inner view of antenna.

Fig. 6. *Epistrophe biarcuata*, n. sp., abdominal pattern of male.

Fig. 7. *Xanthandrus flavomaculatus* Shannon, abdominal pattern of male (a free hand sketch of type).

Fig. 8. *Xanthandrus nitidulus*, n. sp., abdominal pattern of male.

Fig. 9. *Xanthandrus plaumanni*, n. sp., abdominal pattern of female.

Fig. 10. *Rhysoys currani*, n. sp., abdominal pattern of male.

Fig. 11. *Melanostoma lineata*, n. sp., abdominal pattern of male.

Fig. 12. *Salpingogaster liposeta*, n. sp., wing of female.

Fig. 13. *Salpingogaster liposeta*, n. sp., mesonotum.

Fig. 14. *Quichuana pogonosa*, n. sp., profile of head of female.

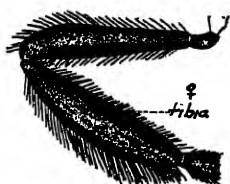
Fig. 15. *Habromyia chrysotaenia*, n. sp., abdominal pattern of male.



1. *T. currani*



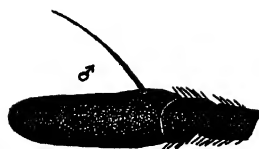
2. *T. lasiotibialis*



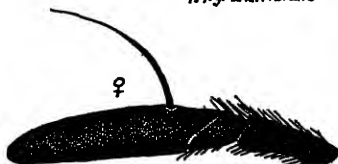
4. *T. granditibialis*



6. *E. biarcuata*



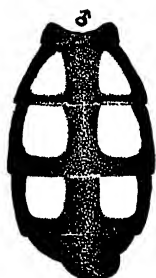
3. *T. lasiotibialis*



5. *T. granditibialis*



10. *R. currani*



7. *X. flavomaculatus*



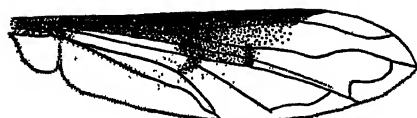
8. *X. nitidulus*



9. *X. plaurmanni*



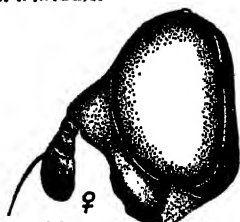
11. *M. lineata*



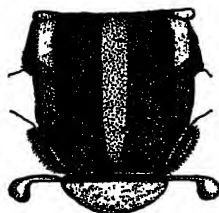
12. *S. liposeta*



15. *H. chrysotaenia*



14. *Q. pogonosa*



13. *S. liposeta*

(See opposite page for captions.)

MALE.—Head black, the yellow of the face diffuse and confined narrowly to the sides, somewhat broader below; the median black stripe very broad and shining; yellow areas and cheeks lightly whitish pollinose, with a dash just below the antennae; pile of face black, of the cheeks whitish. Facial tubercle prominent, broad and almost nose-shaped. Frontal triangle aeneous, shining and rough just above the antennae, rest of front thinly brownish pollinose, which becomes thicker and light brown in color along the orbits, pile all black. Ocellar triangle opaque black, pile black. Occiput very narrow above with black cilia; below gray pollinose with whitish pile. Antennae brown, third segment yellow below; arista brown.

Thorax aeneous, almost dull, the mesonotum with two widely separated narrow opaque black vittae. Pile of the mesonotum yellowish brown, the tips of the hairs black on the anterior half. Scutellum black with a dull ochreous cast; shining bluish on the sides; pile black, ventral fringe brownish. Notopleura, mesopleura, upper half of the sternopleura and pteropleura brownish pollinose; pile yellowish to brownish, black on the pteropleura. Metasternum thinly hairy.

Legs black; four front femora apically, the four front tibiae basally and the hind knees yellowish brown; pile black.

Wings entirely brownish, darker brown anteriorly. Squamae light brownish yellow, the upper fold black at the base; halteres yellow.

Abdomen opaque black; the first and fifth tergites and bases, sides and apices of the other tergites shining. Second tergite with two median, elongate, slightly arcuate, oblique yellow spots, which are widely separated and do not reach the sides. Third and fourth tergites each with a pair of basal, widely separated, yellow spots and an arcuated band, convex anteriorly, concave posteriorly, none of which reach the sides. Pile black, yellow on the sides of the first and second tergites. Venter shining.

Types.—Holotype, male, Nova Teutonia, Brazil, July 7, 1936 (Fritz Plau-mann). Paratype, male, same place, Nov. 27, 1936.

XANTHANDRUS VERRALL

In the Journal of the Kansas Entomological Society (April, 1936), I published a key to the species from the Neotropical region. It is interesting to note two new species for this genus from South America and I am republishing the key to bring it up to date. *X. (Melanostoma) eucratum* Bigot, from Mexico, is not included.

TABLE OF SPECIES

- 1.—Face cinereous or whitish pollinose. 3.
 Face golden or golden brown pollinose, the orbits narrowly whitish. 2.
- 2.—Abdomen extensively reddish, bands on third and fourth tergites not interrupted. *cubana* Fluke.
 Abdominal bands broken up into triangular spots. *nividulus*, n. sp.
- 3.—Antennae entirely black, abdomen with only one pair of yellow spots in female; male unknown. *plaumanni*, n. sp.
 Antennae partly yellow beneath the third segment. 4.
- 4.—Second abdominal tergite opaque on not more than the apical third on either side in the female, the second segment normally with reddish spots in female. 5.

- Second abdominal tergite opaque on more than the apical half across its entire width (except the lateral margins) and never with reddish areas; male unknown. *mexicanus* Curran.
- 5.—Second abdominal tergite of male with pair of large, triangular yellowish spots *flavomaculatus* Shannon.
- Second abdominal segment of male wholly black. *bucephalus* Wiedemann.

***Xanthandrus flavomaculatus* Shannon**

Figure 7

SHANNON, 1927, Proc. U. S. Nat. Mus., LXX, p. 6.

The type specimen is a male. Facial pollen and pile almost white; wings hyaline, only lightly tinged with brown; spots on second tergite triangular, on third and fourth tergites nearly quadrate; genitalia large.

***Xanthandrus nitidulus*, new species**

Figure 8

Related to *X. flavomaculatus* Shannon but differs in the golden pruinosity of the face and triangular spots of the abdomen. Length, 11 mm.

MALE.—Head black, the tubercle and a large area of the front shining; face golden pollinose and with yellowish pile which becomes black on the sides near the antennae. Orbital edges of the front silvery pollinose, the pile all black. There is a distinct transverse depression on the inflated front just above the antennal arc. Ocellar triangle black with black pile; occipital cilia black. Antennae brown, the segments yellowish basally and beneath; arista yellow, darker toward the tip.

Mesonotum and scutellum aeneous with shining brassy to bronze cast, pollinose on the sides in front of the suture, the pile all yellowish brown, tips of the hairs darker. Pleura golden pollinose.

Legs light brownish to reddish, the tarsi and hind tibiae darker; pile mostly brownish to black.

Wings dilutely brownish, especially the front halves; squamae yellowish brown, the edges and fringes brown; halteres yellow; plumule white.

Abdomen semi-shining black with three pairs of triangular basal yellow spots; those on the second tergite more oval; spots on the third and fourth tergites reach the sides only by their corners, those on the fourth larger, inner sides of the median pair parallel. Fifth tergite with indications of a pair of very small basal spots. Pile short and black, longer and yellowish on the sides basally. Venter shining. Genitalia black, the styles yellow.

FEMALE.—Very similar; the front shining blue-black, convex above the depression, pile all black, a pair of whitish triangular side dust spots in the depression. Mesonotum darker aeneous, the pile shorter. Abdominal maculation the same.

TYPES.—Holotype, male, Nova Teutonia, Brazil, July 17, 1936 (Fritz Plau-mann); allotype, female, same place, July 18, 1936. Paratypes: 9 males, same data as holotype; 1 male same place, Aug. 20, 1936; and one female same place, Oct. 8, 1936.

All of these specimens are remarkably uniform in size and markings. They are decidedly larger than *flavomaculatus*.

Xanthandrus plaumanni, new species

Figure 9

A shining black species with one pair of yellow spots; frontal hair long and black, antennae black, squamae dull yellow with black edge and fringe. Length, 12.5 mm.

FEMALE.—Face and front shining black, with slight bluish cast in certain lights. Face lightly covered with whitish pollen and pile, the tubercle shining; frontal depression with a pair of small whitish pollinose spots widely separated, rest of front shining with long black pile. Outer edges of antennal pits reddish. Antennae large, entirely black, arista yellow basally, darker toward the tip. Occipital pile white below, black on upper third.

Thorax blue-black, shining, the mesonotum clothed with black pile, becoming pale anteriorly. Pleura lightly dusted with whitish pollen, the pile whitish. Scutellum shining with black pile, a few shorter white hairs intermixed near the apex; the ventral fringe white.

Legs shining black, basal half of the four front tibiae yellowish; pile mostly black, a few long white hairs at the bases of the femora. Wings slightly infuscated, especially across the middle, the stigma yellowish brown. Squamae pellucid, the edges and fringes dark brown; halteres yellow, plumule white.

Abdomen black, bluish in reflected lights; the disc of each segment semi-opaque, the edges shining. A pair of small isolated basal yellow spots on the third tergite, these spots reach the base of the segment and are convex posteriorly, becoming narrower laterally. The fourth tergite has a basal shining area suggesting obsolete yellow markings. Venter with a broad yellow band, one-fourth on the apex of the second sternite, three-fourths on the base of the third sternite. Pile of abdomen mostly black and depressed, white and more erect basally and along the sides. Fourth sternite, basally, and the fifth white pollinose.

TYPES.—Holotype, female, Nova Teutonia, Brazil, Oct. 10, 1936 (Fritz Plaumann). Paratypes: two females, same place, Nov. 21 and Dec. 8, 1936.

This species differs from *bucephalus* Wiedemann in the entirely black antennae, longer black hairs of the front, black hairs of the mesonotum, black fringe of squamae, absence of any markings on the second tergite (female). The male when found will probably be less dark and possess yellow markings on the fourth tergite.

Rhysoys currani, new species

Figure 10

A dark species with triangular side spots on tergites three and four. First segment of antenna elongate, first and second (measured from above) sub-equal to the third; face smooth with only three very faint transverse depressions. Length, 9 mm.

MALE.—Face rusty pollinose; a broad median stripe which forks before reaching the antennae, a narrow band along the side of the face, the oral margin, the lower face, and the area surrounding the antennae, shining; cheeks lightly dusted with whitish pollen; pile of face sparse, pale, becoming black above, all black on the front. Face with a low tubercle. Frontal triangle shining, with a median suture, the orbital margins rusty pollinose, with a prominent black opaque spot in the upper orbital

corner. Ocellar triangle opaque black, the pile dark brown to black; the cilia short and blackish. Antennae yellowish brown, upper half of the third segment darker; first segment longer than the second but shorter than the third; antennal pits widely separated.

Thorax shining black, considerably dulled by rusty brown pollen, which takes the form of two faint median stripes on the anterior half of the mesonotum; pile all yellowish brown. Pleura lightly dusted with brownish pollen.

Legs yellow, apical half of the hind femora, the apical three segments of the middle and hind tarsi, all but the base of the metatarsus of the fore tarsi, the hind tibiae, and the coxae brown to black. The bases of the hind femora are particularly yellow and rather sharply defined in color; the four front femora are somewhat obscurely yellowish brown apically.

Wings luteous, stigma yellowish. Squamae with dark brown border and fringe; halteres yellow, plumule white.

Abdomen velvety black, the rolled-under sides, the first segment, and the genitalia shining; second segment longer than the third; with two pairs of triangular yellowish spots. The second tergite has an elongate narrow yellow streak on each side; spots on the third and fourth tergites located in the basal corners, the first pair reaching the apical half and the second the apical two-fifths. Venter shining.

FEMALE.—Front with a broad, inwardly narrowed, band of opaque black in front of the ocelli; a very narrow pollinose streak borders this band posteriorly; rest of front cinereous pollinose except the large shining spot above the antennae; the pollinose band is almost bisected by a streak of black. Mesonotal pile very short and all pale. The scutellum has two longer black hairs at the apex.

Abdominal spots smaller on the third and fourth tergites, and broadly separated from the sides. Second tergite with a more oval pair of yellow spots. Basal margin of the third sternite yellow.

Types.—Holotype, male, Nova Teutonia, Brazil, July 18, 1936 (Fritz Plaumann); allotype, female, same data. Paratypes: five males, same place, July 18 and Sept. 1, 1936; two females, same place, Sept. 1 and Oct. 20, 1936.

According to Dr. Curran,¹ this species belongs to *Rhysops*, because of the length of the antennae, the second segment being longer than wide. The transverse grooves of the face are very faint, otherwise the face has the general appearance of *R. rugosonatus* Williston, the genotype. Of the described species this comes the nearest to *Melanostoma catabomba* Williston but may be told from it by the color of the legs, velvety spot of the front, etc.

Melanostoma lineata, new species

Figure 11

Antennae short; abdomen with elongate linear yellow spots. Length, 7.5 to 9 mm.

MALE.—Face almost perpendicular with two faint transverse depressions, the tubercle elongate, broad and low; shining black, the sides white pollinose, heavier

¹ See American Museum Novitates No. 926.

next to the eyes; the pile pale, sparse. Cheeks shining, lightly whitish pollinose. Frontal triangle rough, but shining above the antennae, broadly cinereous pollinose along the eyes, more whitish next to the orbits, the pile black. Ocellar triangle black, with black pile; occipital pile fine, short and black; occiput narrow, even below; silvery pollinose below. Antennae yellowish, darker toward the end and above on the third segment; first segment only very little longer than the second which is wider than long; the third slightly less in length than the first two together; the whole only about half as long as the face.

Mesonotum shining aeneous with a slight bronze cast, with yellowish brown pile; two very faint anterior median pollinose striae; hairs of the scutellum longer, some of the apical ones black. Pleura lightly coated with brownish to rusty colored pollen, the pile yellowish.

Legs black; basal one-fourth of the hind femora, apical one-third to one-half of the four front femora, all of the four front tibiae, and basal third of the hind tibiae yellow; the basal segment or two of the tarsi yellowish to brownish. No peculiar hairs present on the legs.

Wings hyaline, slightly tinged with brown, the stigma yellow. Squamae white, halteres yellow.

Abdomen narrow with nearly parallel sides, mostly shining black, the disc of tergites two and three more opaque. Second and third tergites each with a pair of elongate yellow vittae, both start basally, the first pair reaching the apical third and the second the apical half of the segments.

FEMALE.—Quite similar to male. Front with a broad, very narrowly bisected, brownish pollinose crossband, occupying the frontal depression; between this band and the ocelli a somewhat narrow black opaque band. Yellow areas on antennae and legs more extensive than on the male. Wings hyaline, abdomen more shining and there are small elongate spots on the second tergite.

TYPES.—Holotype, male, Nova Teutonia, Brazil, Sept. 2, 1936 (Fritz Plau-mann); allotype, female, same place, July 7, 1936. Paratypes: three males, same place, July 6, 7 and Sept. 1, 1936; two females, same place, Sept. 1 and 2, 1936.

This species should be readily recognized by the vittate spots on the abdomen; the flat, practically non-rugose face, and the short antennae. It resembles closest *Rhyssops* (*M.*) *scitula* Williston but the coloring of the legs will readily distinguish it.

Salpingogaster liposeta, new species

Figures 12 and 13

Facial tubercle reddish brown; mesonotum with a single median cinereous vitta; basal two-thirds of the fore margin of the wing blackish and with a dark transverse spot near the middle. Length, 12 to 13 mm.

FEMALE.—Head yellow, lightly whitish pollinose; a broad dark red area runs from the upper oral margin across the tubercle, across the antennal pits up the front and to the ocelli, narrowing as it approaches the ocelli; this leaves the sides of the face and front yellow. Cheeks light red, a narrow darker streak from the eyes to the side of the oral opening. Ocellar triangle black; occiput covered with grayish pollen

and white pile. Pile of head everywhere very short and pale. Antennae reddish brown, arista brown.

Mesonotum rough, dark, with very short fine pile; on the sides from the humeri to the suture, yellow; with a broad median yellowish brown pollinose vitta. Scutellum yellow, the base narrowly brownish. Pleural and sternal sclerites reddish, finely and thinly white pollinose, the sternopleura and posterior two-thirds of the mesopleura yellow; non-pilose.

Legs reddish brown to black; apices of the femora and basal one-third to one-half of the tibiae yellow.

Wings brown in front of the spurious vein as far out as the apical third of the first basal cell, brown in the apex of first basal cell to near the anterior cross vein, tinged with brown posteriorly and basally; apex of wing, all of the second basal cell and all but the anterior half and apex of first basal cell, hyaline. Squamae yellowish, halteres yellow.

Abdomen semi-shining black, basal corners of tergites one, three, four, five and apical margins of three and four yellowish white. Abdomen suddenly widening at the beginning of the third segment. Venter shining black. Pile of abdomen very short, black on the black areas, pale on the basal segments and white spots.

Types.—Holotype female and two paratype females, Puerto Grande, Isla Puna, Ecuador (F. Campos, R. Santiago, A. Navarro).

This species runs to *bicolor* Sack in Curran's key ('Diptera of British Guiana'). It should be easily recognized by the wing coloration, thoracic vitta, abdominal markings, etc.

Quichuana pogonosa, new species

Figure 14

A dull black species closely related to *Q. sylvicola* Knab; the pile on the face, and the tuft on the mesopleura and notopleura brassy yellow, fore margin of the wings darkened. Length, 9 to 10 mm.

Male.—Head black, the face, cheeks and occiput with brassy pile, a few long black hairs overhanging the eyes above and in the center of the frontal triangle; face gray pollinose, a median stripe over the tubercle, but not reaching the antennae, and a stripe on each side shining, devoid of pollen but covered with scattered pile. The side stripes are isolated. Cheeks in front shining, behind pollinose and continuing on to the occiput; upper half of occiput becoming free of pollen; frontal triangle and ocellar triangle shining. There is a shallow double arched depression on the frontal triangle just above the antennae. Face with a low broad tubercle. Antennae brownish to black, the first segment blacker than the third; third a little less than twice as long as wide (much shorter than in *sylicola*); arista reddish yellow. Eyes thickly covered with cinereous pile.

Thorax and scutellum dull black, with two median faint pollinose stripes which fade out before reaching the scutellum; pile all yellowish to brassy, rather heavy, with a prominent tuft of brassy pile on the notopleura and upper part of mesopleura. On the inner side of each humerus a golden pollinose spot. Pile of post alar callosities longer and brassy. On the sides of the notum adjacent to the wings there are patches of short black bristly hairs.

Legs shining black, the knees and hind tarsi reddish; pile pale yellowish. Hind femora decidedly enlarged, the tibiae arcuated.

Wings hyaline except for a dark area along the fore margin in front of the spurious vein; the costal cell and area within the loop of the third vein hyaline. Bases of the squamae yellow, the apices dark brown, fringes light brown. Halteres light yellow.

Abdomen dull black with yellow pile, black only on the apices of second to fourth tergites. The tuft of brassy yellow pile on the first tergite thick and "moustache-shaped," easily seen with the naked eye.

FEMALE.—Similar to the male, the front shining black with very small side triangles of pollen. The side stripes of the face are connected with the shining front.

Types.—Holotype, male, Nova Teutonia, Brazil, Sept. 2, 1936 (Fritz Plaumann). Allotype, female, same place, Aug. 30, 1936 (Plaumann). Paratypes: two males, same place, Sept. 2 and Dec. 20, 1936; five females, same place, Oct. 10, 12, 14 and Dec. 8 and 20, 1936.

Habromyia chrysotaenia, new species

Figure 15

Related to *H. (Quichuana) barbiellini* Ceresa but the principal markings of the thorax are vittate instead of transverse. Length, 9 to 13 mm., average about 12 mm.

MALE.—Head generally dark, the facial stripe black and shining; sides of the face light yellowish pollinose, almost golden in some specimens, the pile rather long and whitish; lower face shining black, the cheeks golden pollinose with similar tomentose pile becoming more golden on the upper occiput. Frontal triangle shining black, the sides yellowish pollinose, pile yellowish white, short; ocellar triangle black, pile black, yellowish pollinose in front of the anterior ocellus. Face concave below antennae, thence convex, the tubercle broad, low. Antennae black, third joint more brownish, becoming yellowish to orange below; arista yellow, tip black, much longer than the antennae.

Thorax dull black with two brownish to golden pollinose vittae, each vitta starts broadly on the inner edge of the humeri, arches inward, almost breaks at the suture then curves outward to connect with the golden tomentose hairs on the post-alar callosity. On each side is a prominent patch of golden tomentose hairs just posterior to the humeri, these patches connect with golden hairs along the posterior edge of the mesopleura, on to the sternopleura and a few on the pteropleura. There is also a faint pollinose stripe along the transverse suture which just reaches the median vitta, also a narrow band of tomentose hairs in front of the scutellum. Other pile of the thorax black, becoming yellow anteriorly. Scutellum dull black, the tip indefinitely translucent yellowish, pile black on disc, yellow at the tip.

Legs reddish to brownish, the first four segments of the front tarsi and the hind femora, except the under side, almost black; in some specimens all the femora and occasionally the tibiae are black; pile mostly all pale, a few fine and short black bristles underneath the middle and hind femora, longer on the inner side of hind femora.

Wings light brownish in front, paler apically, hyaline posteriorly, the entire area within the loop of the third vein hyaline. Squamae light brown, the fringes golded, halteres yellow.

Abdomen dull black with short black hairs, longer and yellowish on the sides, particularly toward the base, the fifth tergite and beyond light brown pollinose, venter with long whitish hairs. Second tergite with a pair of oblique yellowish pollinose bands which do not reach the posterior margin; in some specimens these bands loop outward and extend forward along the sides but become almost yellow to red bands on the sides. These markings can be described as V-shaped, the outer ends encroaching on the apical corners of the first tergite. Basal margins of the third and fourth tergites golden pollinose and briefly tomentose, more broadly so on the sides.

FEMALE.—Similar, but the hairs more golden, especially on the face, and the abdomen is more oval. Front pollinose along the sides, dull black in the middle, third segment of antennae almost reddish. Fifth tergite of abdomen dark brown pollinose.

TYPES.—Holotype, male, Nova Teutonia, Brazil, Sept. 2, 1936 (Fritz Plaumann). Allotype, female, same data. Paratypes: seven males and eleven females, same place, all collected between Aug. 30 to Oct. 17, 1936 (Fritz Plaumann).

This species should be readily recognized by the oblique V-shaped markings on the abdomen and the markings on the thorax.

Habromyia lipoflava, new species

A dark species with few conspicuous markings; face yellowish to reddish in ground color. Length, 11 to 12 mm.

MALE.—Face reddish, silvery pollinose, with a darkened median bare stripe, which is more reddish below the rather large tubercle; cheeks shining black, bare above, lightly gray pollinose below, oral margin shining black. Frontal triangle shining black, pollinose only along the orbits. Pile of the head entirely whitish, only the hairs on the ocellar triangle black. Occiput with yellow globular hairs mixed with the yellowish-white pile above, silvery pollinose below. Antennae brownish red, the arista yellowish, almost white at the tip, the basal half thickened.

Thorax opaque, grayish black, the pile black with a few yellowish hairs intermixed, becoming almost all yellow in front between the humeri. A very narrow band of short globular-like hairs extends along the posterior margins of the mesopleura across the notopleura and follows the transverse suture to one-third the way across the mesonotum; a similar narrow band in front of the scutellum. The sterna and pleura shining black with yellowish-white pile. The scutellum reddish, blacker at the base; the short pile black, the long pile yellowish to white.

Legs mostly shining black, the under sides of all the femora and the bases of the four front tibiae reddish. Pile mostly white, along the lower, inner and basal edge of the hind femora a patch of conspicuous bristle-like black hairs in addition to the usual apical patch. Hind femora greatly thickened.

Wings dilutely yellowish, the stigma only a little darker. Squamae yellow, the fringe light brown. Halteres and plumule yellow.

Abdomen shining black with a bluish cast; apices of the second and third tergites opaque; pile of the tergites short and black, longer and yellow along the sides and toward the base. Sternites with long yellowish pile. Genitalia globose. The apical incisure margins of tergites two, three, and four yellow.

FEMALE.—The globular-like yellow hairs are more numerous on the notopleura

and there are patches of the same kind of hairs at the basal corners of tergites two, three, and four. The legs are more reddish than in the male.

Types.—Holotype, male, Yura, Peru (accession 27465); allotype, female (in poor condition), same data. Paratypes: four males, same data.

The hyaline wings, reddish face and tomentose hairs of the thorax will readily distinguish this species from all others known from South America.

AMERICAN MUSEUM NOVITATES

Number 942

Published by
THE AMERICAN MUSEUM OF NATURAL HISTORY
New York City

Sept. 10, 1937

AN EARLY PLEISTOCENE FAUNA FROM NEBRASKA

BY ERWIN H. BARBOUR¹ AND C. BERTRAND SCHULTZ²

A lower Pleistocene deposit³ containing fossil vertebrates was discovered in 1936, four miles east and one mile north of Broadwater, in NE¹/₂ of sec. 20 and NW¹/₄ of sec. 21, T. 19 N., R. 47 W., Morrill County, Nebraska. This new locality is on land owned by Mr. Dan J. Boman and Mrs. Mary A. Boman of Broadwater, and was reported to the writers by Messrs. S. R. Sweet and T. C. Middleswart of Bridgeport. Four quarries were opened during 1936.

The fossilized remains were found in a white, sandy, argillaceous, diatomaceous earth, and also in lenses of fine, bog-iron stained sand. The bones are light chocolate-brown in color and are often crushed, warped and bent. Sands and gravels occur both below and above the fossil-bearing horizon. These deposits belong to the "upper terrace" of the north side of the North Platte Valley. The fossil-bearing stratum extends some forty miles to the east and several miles to the west.

The character of the deposits at the various quarry sites, together with the fauna, suggests the former presence of swamps. Imprints of fossil reed-like plants occur frequently in the diatomaceous layer and remains of a number of aquatic animals have been found in the quarries. Among the latter are otter, beaver-like rodents, muskrat, and also fishes and frogs.

Twenty-eight mammals are represented. The horse is most abundant. The absence of mammoth, bison and musk-oxen is noted, but the writers believe these forms to be later migrants into that section during the Pleistocene.

The geology, and also the fauna, indicate that the quarries are of lower Pleistocene age, possibly Aftonian. Fossils have already been attributed to the "Aftonian" from Nebraska and near-by localities, but it is very doubtful if many of these specimens are actually of Aftonian age. See chart (Fig. 1) for suggested stratigraphic relationship of the

¹ Professor of Geology and Paleontology, University of Nebraska and Director, Nebraska State Museum.

² Assistant Curator in Paleontology and Senior Field Man, Nebraska State Museum.

³ Barbour, Erwin H., and Schultz, C. Bertrand, 1936, p. 450.

fauna of the Broadwater Quarries and other known faunas from the Nebraska Region.

The American Museum of Natural History and the Frick collections from Hay Springs have aided much in a better understanding of the middle Pleistocene fauna of Nebraska. Until recently very little has been known about the lower Pleistocene. In 1934, the Frick expedition, under the leadership of Morris F. Skinner, opened a new fossil quarry¹ of

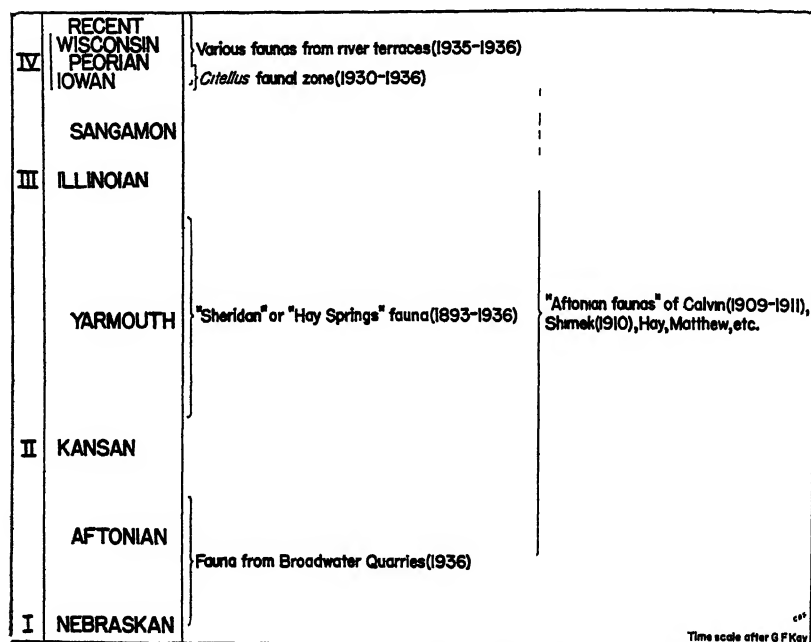


Fig. 1. Chart showing approximate stratigraphic position of fauna from Broadwater Quarries in relation to other known Pleistocene faunas from Nebraska.

lower Pleistocene age in Brown County, Nebraska. In this peat and diatomaceous earth bed were found the remains of a number of stegomastodonts (*Stegomastodon primitivus* Osborn) and a few bones of other Pleistocene mammals. The fauna of the Broadwater Quarries adds to the list of known lower Pleistocene forms and it is hoped that future work in this locality will contribute much more information.

¹ Osborn, Henry Fairfield, 1936, pp. 726-728.

The field work at Broadwater was carried on under the direction of the junior writer for the Nebraska State Museum. Members of the parties who collected at the quarries include Messrs. S. R. Sweet, T. C. Middleswart, W. F. Chaloupka, and John Ochoa of Bridgeport, and Messrs. Thompson M. Stout, E. L. Blue, Frank Crabill, Gordon Graham, David Abbott, Jack Graham, Dean Kerl, and Mrs. Marian Schultz of the Nebraska State Museum expedition, and Mr. Fred Schall of Princeton University.

The writers are deeply grateful to Mr. Childs Frick and Dr. Walter Granger of The American Museum of Natural History and Dr. C. Lewis Gazin of the National Museum for helpful suggestions and allowing the examination of specimens. Mr. Thompson M. Stout has liberally co-operated with the writers in the study of the rodents from the quarries. The drawings for figures 2 to 4 were made by Mr. Ralph Mefferd.

LIST OF MAMMALS FROM BROADWATER AND HAY SPRINGS QUARRIES

Broadwater ¹ (lower Pleistocene)	Hay Springs ² (middle Pleistocene)
INSECTIVORA	
<i>Sorex</i> sp.	
EDENTATA	
<i>Myiodon</i> sp.	<i>Myiodon garmani</i> Allen <i>Myiodon nebrascensis</i> (Brown) <i>Megalonyx leidy</i> Lundahl
LAGOMORPHA	
<i>Lepus</i> sp. <i>Sylvilagus</i> sp.	
RODENTIA	
Sciurid	<i>Cynomys niobrarius</i> Hay <i>Geomys</i> sp. <i>Thomomys</i> ?
<i>Geomys</i> sp. <i>Thomomys</i> ? <i>Procastoroides sweeti</i> , new genus and species	<i>Castoroides ohioensis nebrascensis</i> Barbour <i>Castor</i> sp.

¹ A preliminary list.

² Matthew, W. D., 1918, pp. 226-229.
Frick, Childs, 1930, pp. 70-80; 1937, pp. 199-202, 521-537
Schultz, C. Bertrand, 1934, pp. 357-363.

Broadwater
(lower Pleistocene)

Dipoides?

Peromyscus sp. [near *P. maniculatus*
(Wagner)]

Ondatra sp.

Mimomys?

Microtinid indet.

Zapus sp. [near *Z. hudsonius*
(Zimmerman)]

Neotoma?

CARNIVORA

Canis sp. (near *C. latrans* Say)

Canis sp. [near *Canis* (*Aenocyon*)
dirus Leidy]

Satherium piscinaria middleswarti,
new variety

Felis?

PROBOSCIDEA

Stegomastodon mirificus primitivus
Osborn

PERISSODACTYLA

Equus sp. (near *E. excelsus* Leidy)

Equus sp. (more primitive species)
Equid (very light-limbed form;
known only from a single meta-
podial)

ARTIODACTYLA

Camelops sp. (much larger form than
C. kansanus Leidy)

Tanupolama sp. [much larger form
than *Tanupolama americanus*
(Wortman)]

Camelid, possibly *Titanotylopus*
nebrascensis Barbour and Schultz

Hay Springs
(middle Pleistocene)

Ondatra nebrascensis (Hollister)

Microtus?

Canis latrans? Say

Canis (*Aenocyon*) *dirus nebrascensis*
Frick

Arctodus simus nebrascensis Frick

Mustela vision? Schrober

Smilodon nebrascensis Matthew

Archidiskodon imperator (Leidy)

Equus excelsus Leidy

Equus excelsus niobrarensis Hay

Equus calabatus nebrascensis Frick

Platygonus vetus Leidy

Camelops kansanus Leidy

Camelops vitakerianus? (Cope)

Tanupolama americanus (Wortman)

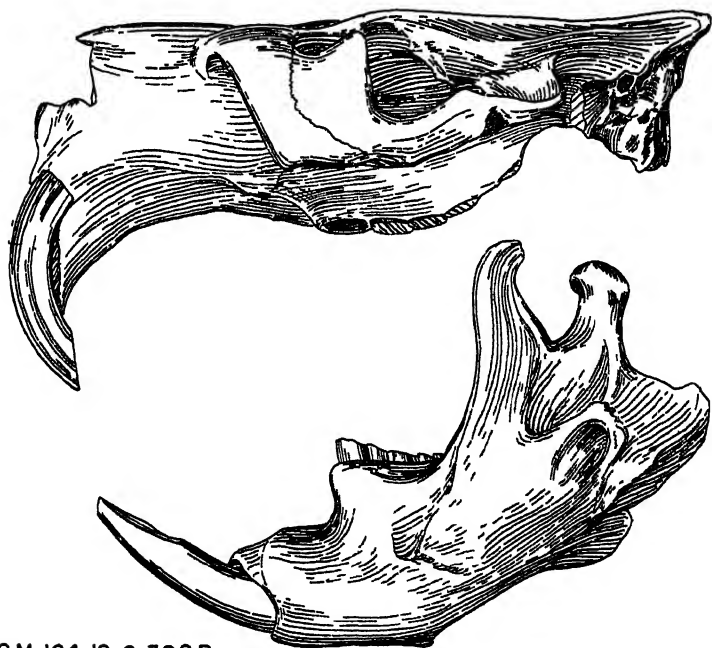
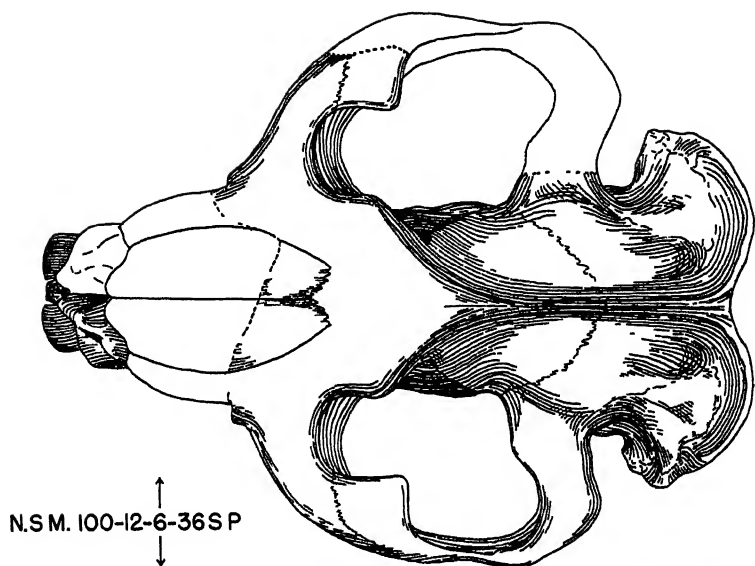


Fig 2 *Procastoroides sweeti* Type. N.S.M. 100-12-6-36 S.P., skull, top and right side; N.S.M. 164-12-6-36 S.P., ramus, right side. One-half natural size.

Broadwater
(lower Pleistocene)

Capromeryx sp. (larger form than *C. furcifer* Matthew)
Antilocaprid, probably *Tetrameryx*

Hay Springs
(middle Pleistocene)

Odocoileus sheridanus Frick
Capromeryx furcifer Matthew
Tetrameryx (Hayoceros) falkenbachii Frick
Bovid

The collection from the Broadwater Quarries also contains the following unidentified vertebrates:

PISCES

Various forms

AMPHIBIA

A very large collection of frog material

REPTILIA

Turtle, perhaps two forms
Snake, at least one form

AVES

Various forms

DESCRIPTION OF NEW MATERIAL

CASTOROIDIDAE

Procastoroides sweeti, new genus and species

TYPE.—Nebr. State Mus. Nos. 100-12-6-36S.P., skull, and 164-12-6-36S.P., left ramus.

REFERRED.—4 skull fragments, 7 rami, 33 molars and premolars, 20 incisors and incisor fragments, 2 scapulae, 4 humeri, 5 ulnae, 2 partial radii, 5 portions of pelvi, 2 femora, 1 tibia, 3 astragali, 4 misc. foot bones, 1 distal phalanx, and misc. ribs and vertebrae from the Broadwater Quarries.

LOCALITY.—Broadwater Quarry 3, NW¹/₄ of sec. 21, T. 19 N., R. 47 W., Morrill County, Nebraska.

HORIZON.—Lower Pleistocene, (?) Aftonian.

GENERIC AND SPECIFIC CHARACTERS.—Form and proportions very beaver-like, approaching those of *Castoroides*; approximately three-fourths of the size of *Castoroides*; incisors without longitudinal grooves but cheek-tooth pattern as in *Castoroides*; skull brachycephalic and more flattened than that of *Castoroides*; width of rear of skull less than one-half its length while in *Castoroides*, rear of skull much wider proportionately; narrowest part of brain-case at the middle of length of skull and just behind orbits as in *Castoroides*; limb elements like *Castoroides*.

DISCUSSION.—The size variation of the referred specimens is great. Upper incisors vary from 8 mm. wide in immature specimens to as much as 15 mm. in old individuals. Perhaps when more material is secured it may be determined that the largest forms represent another variety or species.



N.S.M. 100-12-6-36S.P



N.S.M. 164-12-6-36S.P

Fig. 3. *Procastoroides sweeti*. Type. N.S.M. 100-12-6-36S.P., upper right dentition, reversed; N.S.M. 164-12-6-36S.P., lower left dentition. Natural size.

Thanks are due to Professor William Berryman Scott for suggestions concerning the description of this material.

Measurements of type skull and ramus of *Procastoroides sweeti*, N.S.M. 100- and 164-12-6-36S.P.

	mm.
Length (max., including supraoccipital crest and incisors).....	200.
Basal length.....	167.
Condyllo-basal length.....	177.
Width (max., across zygomatic arches).....	145.
Length of dental series (P ⁴ -M ³) on triturating.....	43.5
Length of P ⁴	12.5
Width of P ⁴	10.5
Length of M ¹	10.
Width of M ¹	10.
Length of M ²	10.
Width of M ²	9.
Length of M ³	11.5
Width of M ³	8.
Max. width of incisor.....	11.5
Length (max., including incisors, measured parallel to grinding surface of premolar-molar series).....	170.
Length from posterior of condyle to tip of incisor.....	156.
Depth of jaw below anterior of P ₄	46.
Length of dental series (P ₄ -M ₃) on triturating surface.....	49.
Length of P ₄	15.
Width of P ₄	10.5
Length of M ₁	13.
Width of M ₁	10.
Length of M ₂	12.
Width of M ₂	10.5

Length of M_3	10.
Width of M_3	9
Max. width of incisor.....	11.5

MUSTELIDAE

Satherium piscinaria middleswarti, new variety

TYPE.—Nebr. State Mus. Nos. 250-12-6-36S.P., incomplete skull, and 251-12-6-36S.P., right ramus.

LOCALITY.—Broadwater Quarry 3, NW¹/₄ of sec. 21, T. 19 N., R. 47 W., Morrill County, Nebraska.

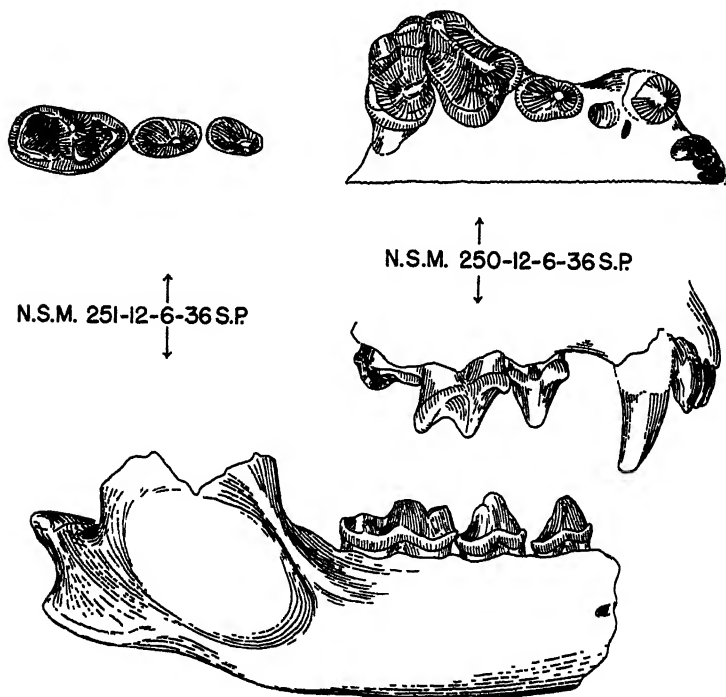


Fig. 4. *Satherium piscinaria middleswarti*. Type. N.S.M. 250-12-6-36S.P., crown and side views of right upper dentition; N.S.M. 251-12-6-36S.P., right ramus and crown view of right lower dentition. Natural size.

HORIZON.—Lower Pleistocene, (?) Aftonian.

DIAGNOSIS.—Very close to *Satherium piscinaria* from Hagerman, Idaho, but slightly larger; lower teeth similar to those of the Hagerman species but carnassial heavier, especially posteriorly; upper carnassial from Hagerman with a much more definite anterior cusp.

Measurements of type skull and ramus of *Satherium piscinaria middleswarti*, N.S.M. 250- and 251-12-6-36S.P.

	mm.
Width of skull between orbits.....	28.
Length of dental series (C-M¹).....	43.5
Length of premolar series.....	32.
Length of P³.....	9.3
Width of P³.....	6.1
Length of P⁴.....	15.5
Width of P⁴.....	11.5
Length of M¹.....	9.5
Transverse diameter of M¹.....	15.
Width across upper incisors.....	16.
Length of ramus from posterior of condyle to anterior of P₃.....	72.5
Depth of jaw below anterior of M₁.....	18.5
Length of P₃-M₁.....	35.
Length of P₃.....	8.5
Width of P₃.....	5.2
Length of P₄.....	10.
Width of P₄.....	6.2
Length of M₁.....	17.
Width of M₁.....	9.3

REFERENCES

- BARBOUR, ERWIN HINCKLEY. 1931. 'The giant beaver, *Castoroides*, and the common beaver, *Castor*, in Nebraska.' Bull. Nebr. State Mus., I, No. 20, June, pp. 171-186.
- BARBOUR, ERWIN HINCKLEY, AND SCHULTZ, C. BERTRAND. 1936. 'Palaeontologic and geologic consideration of early man in Nebraska (with notice of a new bone bed in the early Pleistocene of Morrill County, Nebraska).' Bull. Nebr. State Mus., I, No. 45, April, p. 450.
- CALVIN, SAMUEL. 1909. 'Aftonian mammalian fauna.' Bull. Geol. Soc. Am., XX, pp. 341-356, Pls. xvi-xxviii.
1911. 'Aftonian mammalian fauna, II.' Bull. Geol. Soc. Am., XXII, pp. 207-216, Pls. xviii-xxiv.
- FOSTER, J. W. 1838. 'Organic remains.' Ohio Geol. Surv., 2nd Ann. Report, pp. 79-83, figs. A-D.
- FRICK, CHILDS. 1930. 'Alaska's frozen fauna.' Natural History, XXX, No. 1, Jan.-Feb., pp. 70-80 (list of Hay Springs fauna included).
1937. 'Horned ruminants of North America.' Bull. Am. Mus., LXIX, pp. 196-202, 521-537, figs. 20, 54.
- GAZIN, C. LEWIS. 1934. 'Upper Pliocene mustelids from the Snake River Basin of Idaho.' Jour. Mam., XV, No. 2, May, pp. 137-149, figs. 3-5.
1936. 'A study of the fossil horse remains from the upper Pliocene of Idaho.' Proc. U. S. Nat. Mus., LXXXIII, No. 2985, pp. 281-320, Pls. xxxiii-xxxiii.

- HAY, OLIVER P. 1912. 'The Pleistocene mammals of Iowa.' Iowa Geol. Surv., XXIII, pp. 1-662, figs. 1-142, Pls. I-LXXV.
- KAY, GEORGE FREDERICK. 1931. 'Classification and duration of the Pleistocene period.' Bull. Geol. Soc. Am., XLII, No. 1, pp. 425-466, 9 figs.
- LUGN, A. L. 1934. 'Outline of Pleistocene geology of Nebraska.' Bull. Nebr. State Mus., I, No. 41, Pt. I, Oct., pp. 319-356.
1935. 'The Pleistocene geology of Nebraska.' Bull. Nebr. Geol. Surv. (2nd Ser.), No. 10, pp. 1-223.
- MATTHEW, W. D. 1918. 'Contributions to the Snake Creek fauna (with notes upon the Pleistocene of western Nebraska).' Bull. Am. Mus., XXXVIII, Art. 7, Apr. 18, pp. 226-229.
- OSBORN, HENRY FAIRFIELD. 1936. 'Proboscidea.' Monograph Am. Mus., pp. 726-728.
- SCHULTZ, C. BERTRAND. 1934. 'The Pleistocene mammals of Nebraska.' Bull. Nebr. State Mus., I, No. 41, Pt. II, Oct., pp. 357-393, table A.
- SHIMEK, B. 1908. 'Aftonian sands and gravels in western Iowa.' Science (n.s.), XXVIII, p. 923.
1909. 'Aftonian sands and gravels in Iowa.' Bull. Geol. Soc. Am. XX, pp. 399-408, Pls. XXXIII-XXXVII.
- WILSON, ROBERT W. 1933. 'A rodent fauna from later Cenozoic beds of southwestern Idaho.' Carn. Inst. Wash. Pub., No. 440, pp. 117-135, figs. 1-8, Pls. I-II.

AMERICAN MUSEUM NOVITATES

Number 943

Published by
THE AMERICAN MUSEUM OF NATURAL HISTORY
New York City

21-2
Sept. 13, 1937

A NEW JURASSIC MAMMAL

By GEORGE GAYLORD SIMPSON

One of the secondary objectives of the American Museum expedition of 1897 was to seek mammals in the Morrison Formation of Wyoming. Marsh's famous Jurassic mammal locality, Quarry 9 at Como Bluff, Wyoming, was reopened and several tons of matrix were quarried out and worked over locally during the following winter. Many bone slivers and reptile teeth and small jaw fragments were found, but the effort was written off as a failure as far as mammals were concerned and the apparently valueless material was put away at the Museum and forgotten. Now nearly forty years later it is found that one of the small jaws that was half hidden in matrix in this lot of material is a mammal, and one of unusual importance. It belongs to one of the rarest Jurassic families, Paurodontidae, and reveals a hitherto unrecognized genus and species.

This remarkable discovery is all the more welcome and unexpected, since it was believed that all the available Jurassic mammal specimens had been located and examined in the course of my work on this subject in 1923-1927, and, since, new field discoveries have not been forthcoming. Professor Osborn also had been very active in this field years before, especially in 1887-1888, before this specimen was actually collected, but also until about 1907 (after which he devoted most of his time to the more advanced mammals). He was particularly anxious to obtain such specimens for the Museum, and it is ironic that work planned by him for this purpose did indeed obtain one of outstanding importance and that he was never aware of this fact.¹

The history of discovery of Jurassic mammals, in which the present specimen must occupy a peculiar place, is in any event a strange one. The first discovery, but not recognition, was made in 1764, before there was a science of vertebrate paleontology, and the rediscovery or in a true sense the real discovery (1812 or 1814) and the first publication (1824) were contemporaneous with the rise of the infant science. Thereafter

¹ This appears actually to be the only Jurassic mammal ever collected for the American Museum. Its collections include a few jaws, of less interest as merely duplicating better specimens in the Marsh Collection, but these were part of the Cope Collection. They were obtained for Cope at Como Bluff, and presumably from Quarry 9, by F. H. Williston in 1880 (that is, while Marsh was working the quarry).

new discoveries rapidly piled up first in England (mostly before 1871) and then in the United States (principally 1878–1886), until there were in museums literally hundreds of these little jaws, which nevertheless are rightly considered among the rarest of fossils. Then the flood of discovery abruptly ceased and so far has never been resumed. The known localities have been intensively reworked, with very little result. In spite of the subsequent extension of collecting activities to the whole world and of constantly accelerated rate of discovery in almost every other field of vertebrate paleontology, no new localities of any importance have been found, and the number of Jurassic mammals collected in the last fifty years is negligible. As far as I know, only two Jurassic mammal specimens have been found in the present century, and none in the last twenty years, if one excepts the present specimen which might be said to have been found in 1897 and discovered in 1936.¹

This delicate specimen has been skilfully prepared by Mr. Albert Thomson and illustrated by Mr. John C. Germann.

PANTOTHERIA

Paurodontidae

ARAODON,² NEW GENUS

TYPE.—*Araeodon intermissus*, new species.

DISTRIBUTION.—Morrison Formation, Jurassic, Wyoming.

DIAGNOSIS.—Cheek teeth seven or eight, probably $P_3 M_4$. P_1 minute, following tooth large, typically premolariform. M_1 (fourth tooth counting from posterior end of series) molariform, with small and low but distinctly cuspidate paraconid and metaconid subequal in height, paraconid projecting anteriorly and shelflike, talonid very small, subtriangular, internal, unbasined. Two roots of each molar subequal. M_4 somewhat reduced in size.

The probable presence of seven cheek teeth (surely not over eight), relatively elongate trigonids, single-cusped and unbasined molar talonid, two subequal molar roots, and relatively short and stout jaw all show that this genus definitely belongs in the Paurodontidae. It appears to be rather closely related to the typical genus of that family.

The paurodontid genera previously known from lower teeth are *Peramus* of the English Purbeckian and *Paurodon*, *Archaeotrigon* and *Tathiodon* of the American Morrison. Confusion with *Peramus* is impossible, and close comparison is unnecessary. In that genus the jaw is

¹ The only possible exception to this statement known to me is the discovery of some specimens in the Jurassic of Argentina which may have been mammalian but were not demonstrated to be so. They were never described or figured and have been irretrievably lost.

² *Apalos*, weak, *doles*, tooth.

more slender and elongate than in *Araeodon*, the dental formula is probably significantly different, and the molar structure is very distinct.

In *Paurodon* the number of cheek teeth is six, surely less than in *Araeodon*, the teeth are widely spaced, with a post-canine diastema whereas they are in continuous series in *Araeodon*, and the internal molar cusps are less distinct than in *Araeodon*. In *Archaeotrigon* the arrangement of the teeth and also the molar structure are closer to *Araeodon*, but the talonid is larger, more semicircular and less internal, the metaconid is higher than the paraconid, and the cheek tooth formula, of the genotype, $P_2 M_3$, is different. In *Tathiodon* the internal molar cusps are much more strongly but unequally developed and the whole structure more similar to the dryolestids than in *Araeodon*. Of the three previously known American genera, *Araeodon* seems most closely to resemble *Archaeotrigon*, but the genera are evidently distinct. It is possible that the referred species *Archaeotrigon distagmus*, in which there appear to have been four molars but the formula otherwise is unknown, will prove to belong to *Araeodon*. Its molar structure seems, however, closer to that of *Archaeotrigon brevimaxillus* than of *Araeodon intermissus*.

***Araeodon intermissus*,¹ new species**

TYPE.—Amer. Mus. No. 27775, right lower jaw with three teeth, probably P_{1-2} and M_1 , and alveoli.

HORIZON AND LOCALITY.—Morrison Formation, Quarry 9, Como Bluff, Wyoming.

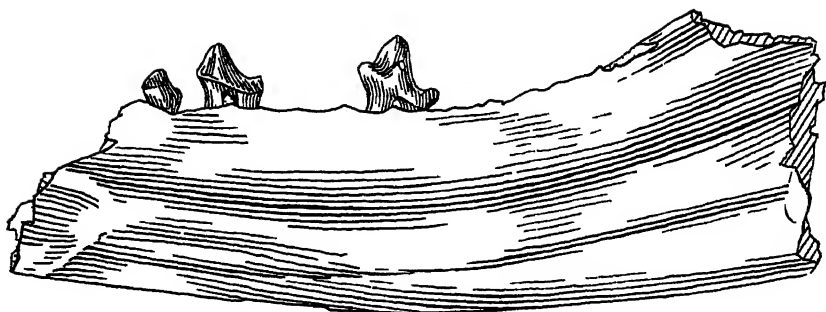
DIAGNOSIS.—Sole known species of genus. Description and measurements below.

The striking superficial characters of this little jaw are its minute size, the small size of the teeth in comparison with the jaw and (in comparison with most pantotheres but not with most of the more familiar Tertiary mammals) its short jaw and small number of teeth.

The anterior alveoli are obscure. There were evidently incisor alveoli, but their number and arrangement cannot be surmised with any assurance. Immediately anterior to the first tooth preserved is a slightly crushed area that seems with considerable probability to involve a single alveolus larger than that for the preserved tooth, and hence probably for a canine. If for a premolar, this must have been the first.

The first tooth preserved, which thus seems to be P_1 , is very small. The root is single at the mouth of the alveolus, but is elongate anteroposteriorly and with traces of division, so that it may divide deep in the alveolus. The crown is relatively low, elongate, and slightly procum-

¹ *Intermissus*, put off, neglected.



A.M.27775 ◇◇

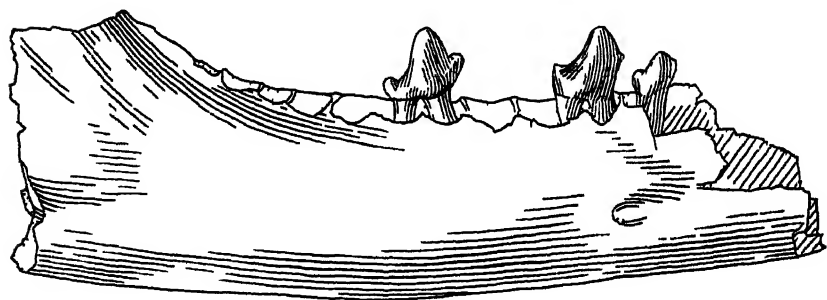


Fig. 1. *Araeodon intermissus*, new genus and species.

Type, American Museum No. 27775, right lower jaw. Internal, superior and external views. Eight times natural size.

bent. The external face is smooth and slightly bulbous. The internal face has a vague basal swelling, hardly definite enough to be called a cingulum, ending anteriorly in a faint rudiment of a cuspile. The main portion of the crown is followed by a very small heel with one tiny cuspile.

The next tooth, probably P_2 , is much larger and has two subequal, well-separated roots. The crown is closely similar in form to that of P_1 , but its structure is more definite. There is a narrow but distinct internal cingulum, the anterior end higher than the posterior, meeting the anterior border almost at a right angle. At this point is an angulation or rudimentary cuspile. Poorly developed semitrenchant crests descend anteriorly and posteriorly from the main apex. The heel bears a small but definite cuspile.

This tooth is followed by two alveoli, suggesting a tooth of about the same size or slightly larger. Identification of this tooth must be largely conjectural, but it seems slightly more probable that it was a premolar, in which case the formula was:

$$?.134^1$$

The next tooth is clearly a molar, and is tentatively designated M_1 . It is implanted by two subequal roots. The trigonid is relatively very large, moderately elevated, and longer than broad. The external face is simple and convex. The protoconid has the usual asymmetrically triangular form, with feeble crests to paraconid and metaconid. The metaconid is internal to the posterior part of the protoconid, with which it is basally confluent, only the apex being distinct. From the alveolar border, this apex is at about two-thirds the height of the protoconid and it is simple and rather blunt. The paraconid projects anteriorly, somewhat anterointernally, and is shelflike, but is a distinct cusp similar to and about as high as the metaconid. It is feebly crested along the internal margin of the tooth, posteriorly from the apex, tending to make a trigonid basin which is, however, only in most rudimentary form. The talonid is low and very small. In plan it is like a tab or ear, subtriangular and wholly on the internal half of the tooth, and is unbasined and slopes downward externally as in most pantotheres. The cuspile is worn, but must have been minute and inconspicuous even when complete.

From their alveoli, M_2 and M_3 were about equal to each other and slightly larger than M_1 , while M_4 was the smallest of the molars, with

¹ Within the Pantotheria, this agreement with the marsupial formula can only be considered accidental, or convergent, if it is confirmed. Its only broad significance would be to demonstrate that pantotheres could give rise to such a formula, and this would hardly be doubted in any event.

the posterior root smaller than the anterior. The coronoid arose immediately posterior to M_4 , but at a low angle. Indeed the alvcolar mouths of M_4 are tilted and on the base of the gently rising coronoid.

There is the usual paurodont type of short, rugose, unfused symphysis. The posterior mental foramen is beneath the anterior root of P_2 . The masseteric fossa is shallow and its pointed anteroinferior end is bounded by a rounded and rather vague margin. The internal groove is well defined, evenly curved, simple, and continuous to the posterior end of the symphysis.

The tooth dimensions in millimeters are:

P_1		P_2		M_1	
L	W	L	W	L	W
0 4	0 2	1 0	0 6	1 1	0 7

Depth of jaw internally beneath M_2 : 3.4.

AMERICAN MUSEUM NOVITATES

Number 944

Published by
THE AMERICAN MUSEUM OF NATURAL HISTORY
New York City

Sept. 13, 1937

AN ALBINO TARPON, *TARPON ATLANTICUS*, THE ONLY KNOWN SPECIMEN

By E. W. GUDGER

One of the most beautiful and interesting specimens, which has of late come to the American Museum, is a mounted albino tarpon, the gift of Mrs. Olivia Erdmann Kuser of Titusville, New Jersey. It has been placed in the Hall of Fishes, where it has attracted much attention. It was caught on May 20, 1936, by Mrs. Kuser in Boca Grande Pass, between Boca Grande and Cayo Costa Islands, west coast of Florida, north of Fort Myers. Seeing that it was a most unusual specimen, Mrs. Kuser, who is a member of the Museum, had it mounted, and has presented it for display in the Hall of Fishes.

This specimen of *Tarpon atlanticus* was taken with ordinary tarpon tackle and it behaved as an ordinary tarpon does when hooked. Not until it was brought up to the side of the boat was it seen that it was an unusual specimen. When it was noticed that it was an albino, instead of being gaffed, it was brought in by hand and carefully handled so that it might be a perfect skin for the taxidermist. Mrs. Kuser telegraphed me at once, and eventually this unique mounted specimen reached the Museum.

When caught, the fish weighed 27 lbs., but no measurements were recorded. Now the mounted fish measures 3 ft. 9 in. from tip to tip, and its depth is 9 in. Except in color, it is in all respects a normal medium-sized tarpon. In the process of skinning and degreasing the skin before mounting, the original slight pinkish color largely went out. However, the captor made careful color notes while the fish was fresh and after the mount reached the Museum, she brought these notes to our Department of Preparation and carefully supervised the skilled artist who colored the fish under her critical supervision.

That the reader may get a better idea of the beautiful coloration of this specimen, comparison must be made with a normal fish. Such is to be seen in Fig. 1 made from a photograph of a splendidly mounted tarpon hanging on the eastern wall of the Hall of Fishes. Here the huge scales are a brilliant silver. From this comes one of the names of the tarpon—the silver king. And the living fish in the clear waters of southern Florida justifies its name, for it is truly a regal fish. Note that in

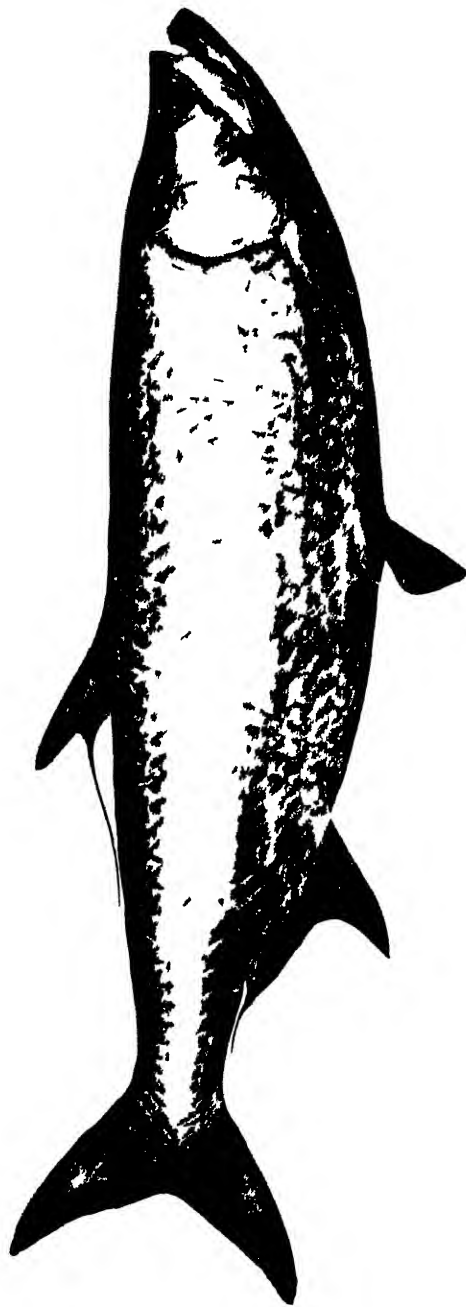


Fig 1 Photograph of a mounted normal tarpon, *Tarpon atlanticus*, on the eastern wall of the Hall of Fishes
in the American Museum

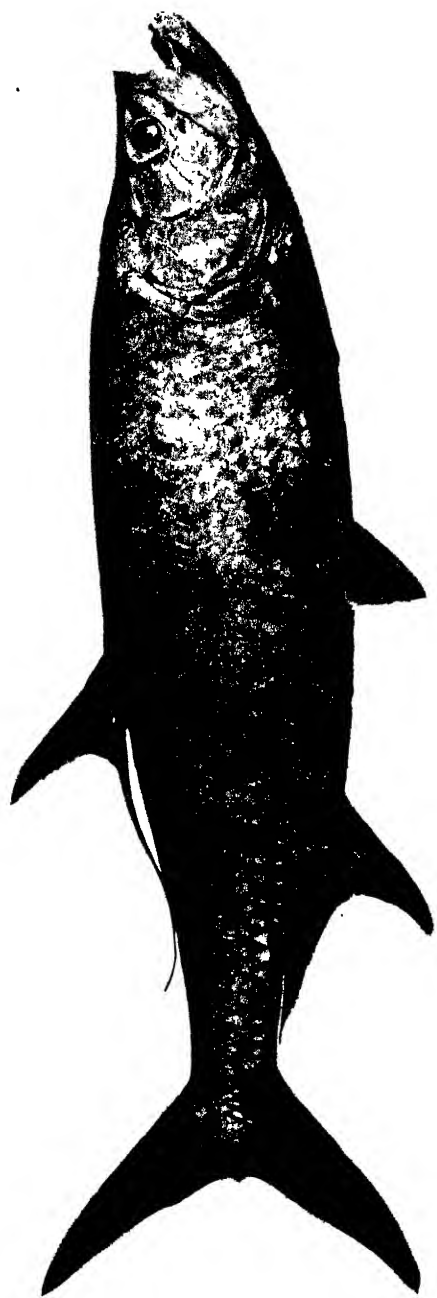


Fig. 2. Photograph of the mounted albino tarpon, hanging on the western wall of the Hall of Fishes in the American Museum.

Fig. 1, the under surface is almost white, the back almost black and the fins hardly less so.

As Fig. 2 shows, the specimen being described is an albino. It is white with pink or reddish eyes. But when examined in a good light it is seen to have an underlying very faint yellow-gold tint with a suggestion of orange-red stippling. The orange-red color becomes somewhat stronger on the head and especially on the branchiostegals. This stippling is also seen to grow slightly denser as one's eye travels toward the mid-dorsal region. Here, where in the normal living fish the color is a metallic purplish-blue or black, there are found a number of black patches, each covering a part of a white scale or spreading over parts of two or more scales. The situation here is just what one finds in some goldfish with black spots on the dorsum. The fins are orange-red, markedly so at their bases. The color diminishes toward the edges, which were transparent in life. But, even considering all these minor things, this tarpon is a true albino. The faint coloring just described is not apparent in the photograph, which shows only the black patches.

In the animal kingdom, albinism is an infrequent but by no means unknown phenomenon. Albinos are found in all the divisions of the vertebrata from man to fish. There are albino races in mammals and in fishes, in white rats and in white trouts. In fishes generally, albinos are more common in the salmonid and flatfish groups. In the first group, they are found among young fish in hatcheries and are segregated and raised and bred as curiosities. In the case of flatfishes, these are trawled in great numbers and since the flatfishes have flat wide bodies, a specimen devoid of color catches the eye very readily. Of the fourteen albino fishes distinctively recorded in Dean's 'Bibliography of Fishes,' three or one-fifth are flatfishes.

I have been working on abnormal fishes for 10 years. This fact has become pretty well known and all kinds of abnormalities have been reported to me from the eastern half of the United States, and so many specimens have come in that I have had a special tank built to store these teratological fishes. But in all this time, this is the first real albino fish to come to me.

This fish is unique. No albino tarpon is recorded in the 'Bibliography of Fishes' (1914) and, so far as I know, none has been listed since. Nor indeed has albinism been described for any of the tarpon's close kindred—for any fish in the herring tribe. These facts make our specimen all the more interesting and valuable.

The cause of albinism is a mystery. It is a congenital phenomenon. An albino is born with a lack of the coloring matter, the chromatophores, in the skin. Our albino tarpon hatched out of the egg an albino.

AMERICAN MUSEUM NOVITATES

Number 945

Published by
THE AMERICAN MUSEUM OF NATURAL HISTORY
New York City

Sept. 13, 1937

A GLUT HERRING, *POMOLOBUS AESTIVALIS*, WITH AN ATTACHED COLONIAL HYDROID, *OBELIA COMMENSURALIS*

By E. W. GUDGER

On March 27, 1936, Mr. Aycock Brown, a valued correspondent at Beaufort, N. C., wrote me that there had been taken in neighboring waters, a glut herring with an attached algal or hydroid growth, and his pencilled sketch showed this admirably. He stated that this specimen had been turned over to Dr. H. F. Prytherch, Director of the U. S. Bureau of Fisheries Laboratory at Beaufort. I at once wrote Dr. Prytherch urging him to describe this interesting fish and growth. This he promised to do,



Fig. 1. The fish (*Pomolobus aestivalis*) and the hydroid (*Obelia commensuralis*)

but his interests were in other forms of life and his time was crowded with other work. So presently he presented the fish to the American Museum, at the same time urging me to describe it, especially since (as he wrote), "You have published on this phenomenon of hydroid growths on fishes." The articles that I have written on this phenomenon being compilations of accounts deeply buried in the literature, I welcome the opportunity of describing at first hand a case of this kind.

THE FISH WITH THE HYDROID GROWTH

The fish in question was identified by my colleague, Mr. John T. Nichols, as the common "glut herring," *Pomolobus aestivalis*. It ranges from St. John's River, Florida, to the British Maritime Provinces, but is especially abundant in the North Carolina sounds where it is found in great schools. It is a small fish, the present specimen measuring 10.4 in. long from tip to tip, and 2.4 in. in depth. Its present weight is 6 oz. The hydroid has been identified by Dr. Willard G. Van Name as *Obelia commensuralis* McCrady. Its range is from South Carolina to Nova Scotia.

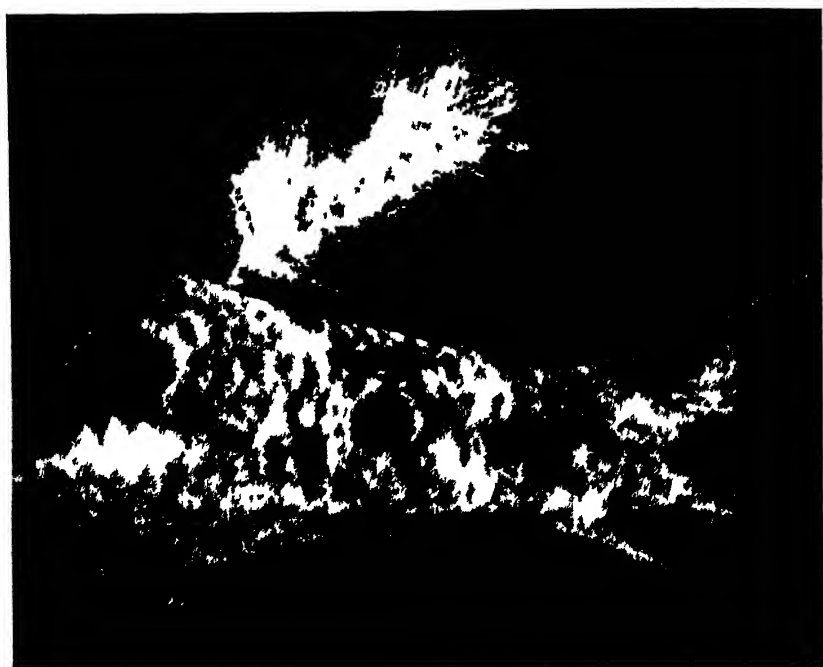


Fig 2 Enlarged view of tail of fish with attached hydroid, to show details

Fig. 1 shows the fish lying on its side in a dish of water with the hydroid floating free at an angle of about 45° to the axis of the host. The fish in handling has lost a number of scales particularly behind the gills, but is otherwise in very good condition. There is nothing to show that the herring when alive was not entirely healthy and normal. Fig. 2 shows the tail portion of the fish and the hydroid much enlarged, to give more detail.

The fish and associated hydroid were taken February 18, 1936, by Burnie F. Willis of Beaufort, in Bogue Sound, opposite Morehead City, N. C. It was found in a catch of other fishes in a haul seine, and was only distinguished from other glut herring by the plumose hydroid attached to its back. Fortunately Mr. Willis, seeing that it was a "freak" fish, brought it to the Laboratory and presented it to Dr. Prytherch.

The hydroid (*Obelia commensuralis*) grows exactly midway between the hinder base of the dorsal fin and the origin of the caudal fin (45 mm. from each). It arises squarely in the mid-dorsal line in a funnel-shaped opening. The horny stem, where it emerges from underneath a saddle-like dorsal scale, has been frayed down to the size of a no. 8 thread. Farther out in the colony where it is of normal size, this stalk measures about 1.5 mm. in diameter. The central stem, growing smaller all the way may

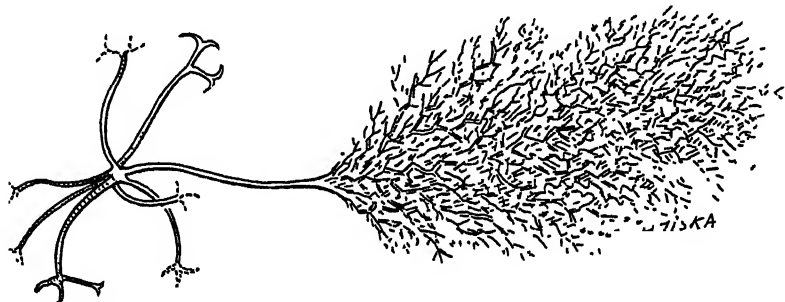


Fig. 3. Drawing of hydroid (diagrammatic) and of hydrorhiza to show proliferation of holdfasts for anchorage in muscular tissues of the fish.

be traced out as a main stalk about 37 mm. from the point of emergence. The total length from point of emergence to tip of outermost "frond" is 47 mm. The greatest breadth of the growth is about 25 mm. as it floats in water. The hinder (under) side of the main stem for about 18 mm. backward is devoid of branches. This must have rested on the back of the fish when this was swimming. And curiously enough the dorsum of the fish from the point of attachment of the hydroid 38 mm. backward is light in color, the epidermis is gone and the scales are soft and formless—the bony material is gone. There seems here to have been both erosion and corrosion. The rubbing of the horny hydroid has probably worn off the epidermis, and since the hard part of each scale is gone one wonders if the hydroid gave off some kind of acid which decomposed the scale.

In surface view this looks like a case of parasitism. The hydroid is

surely rooted not in the scales and epidermis of the fish, as has been reported for other specimens, but in the muscles. To determine this matter I asked help from another colleague, Mr. Harry C. Raven, an expert dissector. When he had got down into the dorsal muscular tissue, what was found is shown in Fig. 3. In this figure the structures are considerably enlarged and the external part of the hydroid is drawn entirely diagrammatically.

The horny stem of the hydroid, just under the scales and skin of the fish, gives off 7 branches in a more or less vertical plane. The most superficial ones cross each other and their extremities were broken off. Two others run clear for a distance of about 3 mm. and then each gives off two or three branchlets. At the node where the branching takes place, 3 branches extend nearly vertically down into the muscles of the fish. One, and the larger, seems central and the others are fore and aft of it. These are anchored in the muscular tissue of the fish's dorsum by a number of small branches. The combination of these holds the hydroid firmly anchored in and to the muscles of the fish.

On first and superficial examination it was plainly seen that the stem of the hydroid emerged from a funnel-shaped hole in the mid-dorsal line of the fish, and that it was firmly and securely anchored in the flesh. In fact it was so solidly fast that it was clear that no ordinary pull would dislodge it. The funnel-shaped hole out of which the stalk emerged had plainly been enlarged by the swaying of the extensive mass of the branched hydroid as the fish swam. Thus it was clear that the hydroid had grown into and had almost become a part of the flesh. Hence the conclusion was formed that this *Obelia* was parasitic on *Pomolobus*, that it was absorbing and living on the tissues of its host as a true parasite. However, this dissection shows that its parts below the scales and skin of the fish are not haustoria for food-absorption but mere holdfasts for anchorage. They have laid hold of the muscles in these unusual surroundings exactly as they would the rough surface of a wooden, concrete or metal pile, or of a shell or any rough surface out in the free water—their normal anchorages in nature. There is no evidence whatever of any wasting away of the muscles; these are entirely normal.

How the hydroid first became attached to the fish is a mystery. It seems plain that it could not affix itself to the relatively large and closely overlapping scales of the herring. We know that the water-molds, *Achlya* and *Saprolegnia*, active and often fatal parasites on fresh-water fishes, can only attack when there is some abrasion of scales and skin. Then by analogy we must conclude that in some way one or more scales

were loosened or torn away on the back of this fish and that at and in this hurt place the floating young hydroid could lay hold with its holdfasts and proliferate these farther and deeper into the flesh of its host and thus anchor itself more and more securely.

I have spoken earlier of having brought together from widespread and hidden sources accounts of colonial hydroids attached to fishes. These may be found in full in an article, "Association Between Sessile Colonial Hydroids and Fishes,"¹ published in 1928. Part of this data was used also in the first of a series of articles bearing the general title "Coelenterates as Enemies of Fishes." No. 1 of this series appeared in 1934.² In these papers all the data concerning the association of hydroids and fishes known to me is brought together, and to these papers the interested reader is referred.

However, it may be well briefly to state here that in the first paper (1928) mere association was shown in the case of four hydroids; alleged but not proven parasitism in two forms; and definite parasitism proven for a hydroid in the *ovarian eggs* of a Russian sturgeon, and for another hydroid found on three fishes in Durban Bay, South Africa. The hydroid (*Hydrichthys mirus*) in this case forms a plate-like hydrorhiza which spreads out over the fins of its host. From the hydrorhiza are sent down into the tissues of the host haustoria which suck up blood until their cavities are filled with red corpuscles. All this was found by cutting sections of hydrorhiza and fin.

In the specimen before me, there is no plate-like hydrorhiza and hence no haustoria for parasitism. The hydrorhiza consists of a simple small stem (Fig. 3) no larger than a heavy thread. This, it is true, penetrates into the flesh of the host but only to break up into many small roots and smaller rootlets. Hence there is here a mere holdfast comparable to what is found on a similar hydroid growing on a pile under a wharf or to some other inanimate object in the open sound or ocean.

What then is the peculiar form of association between these diverse organisms? This is somewhat hard to answer. There is not here the purpose of protection or concealment such as is found in some crabs, hermits or free-livers, where hydroids are actually planted on shell or carapace to hide the host from enemies. It has been shown that there is no parasitism. It seems unlikely that the relationship is a symbiosis since neither gives anything to the other so far as can be seen. It can hardly be a case of commensalism even though both animals feed on microscopic marine organisms.

¹ Gudger, E. W. Ann. Mag. Nat. Hist., 1928, (10) VIII, pp. 17-48, 13 figs.

² Gudger, E. W. Ann. Mag. Nat. Hist., 1934, (10) XIII, pp. 192-212, 7 text-figs., 2 pls.

This leaves for consideration that form of animal association known as inquilinism, or a lodger-host relationship in which neither specifically benefits the other. Does someone say that the hydroid gets carried about and thus has a surer chance of getting its food? But this hardly appeals to one who has seen the luxuriant growth of hydroid colonies on wharf piles. The ebb and flood of the tides surely take care of the matter of the hydroids' food.

To me it seems that the association between *Obelia* and *Pomolobus* is a mere fortuitous or accidental case of feeble and unpurposeful inquilinism.

AMERICAN MUSEUM NOVITATES

Number 946

Published by
THE AMERICAN MUSEUM OF NATURAL HISTORY
New York City

Sept. 14, 1937

ON THE PALATE, OCCIPUT AND HIND FOOT OF *BAURIA* *CYNOPS* BROOM

By R. BROOM, F.R.S.

Bauria cynops, the type of the suborder Bauriamorpha of Watson, is at present known by only two specimens, the type skull in the South African Museum, Capetown, and a specimen found by me a few years later at Winnaarsbaken, which consists of a good skull with some associated limb bones and which is now in The American Museum of Natural History (A. M. No. 5622). Watson in 1912 discovered a considerable part of the skull of a closely allied form, *Baurioides watsoni* and this skull shows much of the palate, but in an unsatisfactory state of preservation.

Two years ago Dr. Boonstra when in New York cleaned out the palate and the foot of the Winnaarsbaken specimen, and these are well worthy of being described.

Though Watson's description of the palate of *Baurioides* is approximately correct, no sutures could be made out, and this new specimen enables us to clear up a lot of points that were in doubt.

There seems to be little doubt that the Winnaarsbaken specimen belongs to *Bauria cynops*. There are four incisors which measure 16.5 mm. This is followed by a diastema of 14.5 mm. The canine is relatively small, its greatest diameter being 5.2 mm. There appear to be ten postcanine teeth, which together measure 35.5 mm. Behind the first and second teeth are parts of other teeth, which are probably the remains of teeth of an earlier set that have been replaced.

There is a well-developed secondary palate which is quite unlike that of any Therapsid previously described. The premaxillaries have each a rather large broad palatine process, which passes back to articulate with the prevomer and the secondary palatal plate of the maxilla, as shown in the figure. There is a small foramen between the palatine process and the prevomer, probably for the duct of Jacobson's organ. The united prevomers form a small part of the anterior part of the palate.

The maxillary teeth form a crescent. The anterior half of the max-

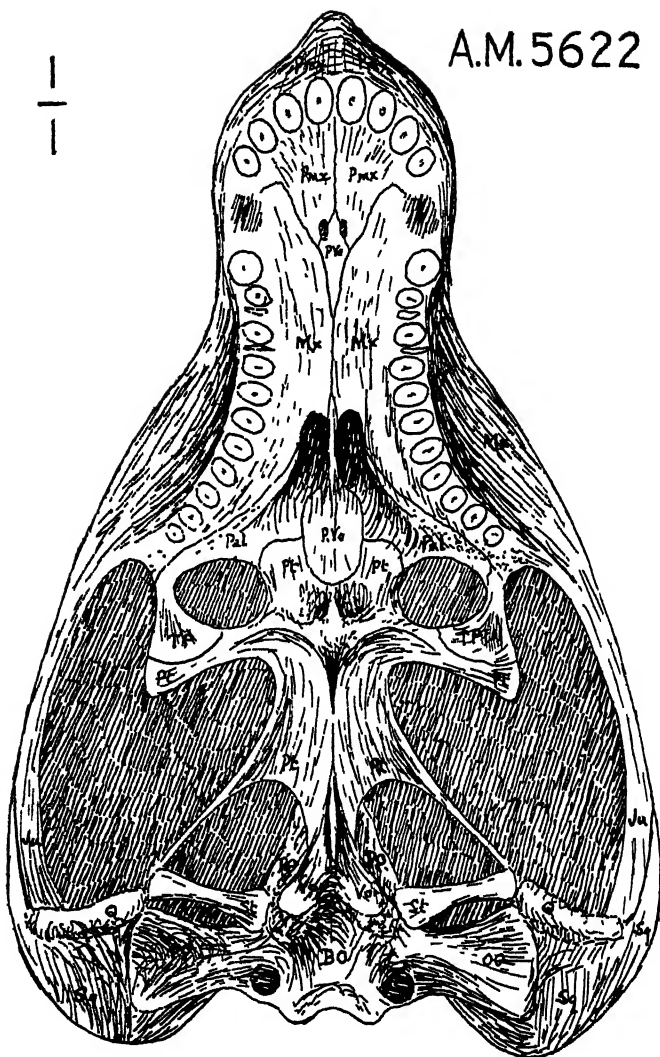


Fig. 1. Under side of the skull of *Bauria cynops*, Broom. Natural size.

B. O., basioccipital; E. O., exoccipital; Ju., jugal; Mx., maxilla; O. O., opisthotic; Pa., parietal; Pal., palatine; Pmx., premaxilla; P. O., prootic; Pt., pterygoid; P. Vo., prevomer; Q., quadrate; S. O., supraoccipital; Sq., squamosal; St., stapes; Tb., tabular; T. P., transpalatine; Vo., vomer (= parasphenoid)

illa has a secondary palatal plate which meets its neighbour, as shown in the figure. It will be seen that the secondary palate is much shorter than in cynodonts, and the posterior nares thus much farther forward. Then there is a more noteworthy character which distinguishes *Bauria* from both the cynodonts and the mammals—the palatine bones take little part in the formation of this secondary palate, and do not meet.

The middle part of the palate is unlike that of any therapsid hitherto described. There is, as Watson has shown in *Baurioides*, a fair sized suborbital vacuity. As in therocephalians, it is bounded by the palatine, the transpalatine and the pterygoid, as shown in the figure. The palatine abuts against the inner side of the posterior part of the maxilla

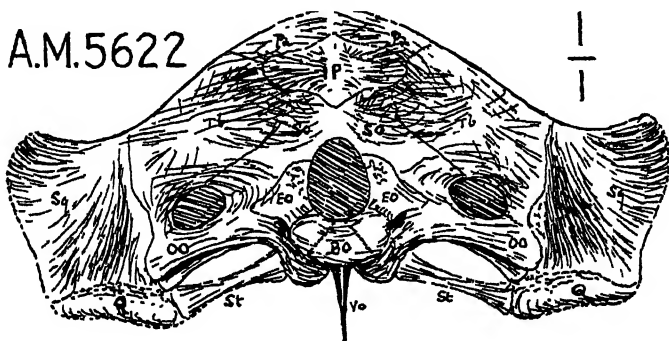


Fig. 2. Occiput of *Bauria cynops*, Broom. Natural size.

and forms most of the outer wall of the posterior nasal passage. In the middle line is a deep vomer-like plate formed by the prevomers. A little behind the opening of the posterior nares the prevomers form a small part of the palatal roof. Behind the prevomers are the large pterygoids. These have the usual broad transverse developments, with long posterior processes and short anterior processes. In the middle line in the plane of the transverse developments is a well-marked median boss, and in front of it two deep pits. Behind the median boss is apparently a very small interpterygoid vacuity. Behind this vacuity the pterygoids send down deep plates, which clasp the descending plate of the true vomer (parasphenoid of most authors).

The vomer (parasphenoid) resembles very considerably that of therocephalians. There is a deep median plate partly clasped by the pterygoids, from which posteriorly thin plates run back on the anterior sides of the tubera. On the outer sides of the tubera are the foramina ovals. The

stapes are fairly long and appear to be imperforate. As the articulators are in articulation with the quadrates, the articular surfaces of these latter are not satisfactorily shown but are probably as indicated in the figures.

The occiput is well preserved. It agrees fairly closely with that of such a therocephalian as *Hofmeyria*. The tabulars are large, and the interparietal very small and entirely confined to the occiput. The exoccipitals, basioccipital and opisthotics are typically therocephalian. The stapes are a little displaced in the specimen, but they probably agree essentially in relations with those of therocephalians. The occipital condyle though broad is single.

The left hind foot is nearly perfectly preserved but the tarsal elements are slightly displaced. There are two large proximal elements—the astragalus or talus, and the os calcis or calcaneum of human anatomy. The astragalus has a large articulation for the tibia and a small outer articulation for the fibula. In front it articulates with the scaphoid or navicular.

The os calcis is considerably larger than the astragalus. It has a convex articulation for the fibula, and a large outer and anterior part, as shown in the figure. The anterior part clearly gives articulation to the fourth and fifth distal tarsals, and it has an outer process. Behind the posterior end of the bone there is a small element which may be a detached part of the os calcis. I cannot decide with certainty whether this is a broken-off portion of the bone or is an extraneous element. It is small and not quite in articulation with the os calcis. If it were originally part of the bone, it would be exactly where a heel should be. I incline to think it is a heel process broken off in crushing. I have given a side view of it as preserved. Watson in his paper on *Ericiolacerta* (1931, Proc. Zool. Soc., p. 1163) shows that this bauriamorph or higher therocephalian has a heel process not unlike that of *Bauria*, assuming the detached fragment to be part of the calcaneum.

There is a fairly well-developed scaphoid or navicular but owing to crushing it is difficult to say exactly how large it is. Most probably it is as shown in the figure.

There are clearly five distal tarsals. The first is a quadrangular bone, as shown. The second is very much smaller, and the third slightly larger than the second. The fourth is much larger than any of the others, and the fifth about the size of the second.

The metatarsals increase in size from the first to the fourth, and the fifth is only a little smaller than the fourth. The first is only a little

longer than the first tarsal. The first phalanx of this digit is also short and the distal phalanx forms a well-developed claw.

The second metatarsal is nearly twice as long as the first. Its upper end articulates with the second tarsal and fits in between the first tarsal and the third almost exactly as does the second metatarsal in man. It



Fig. 3. Left pes of *Bauria cynops*, Broom. Natural size. A. Outer view of calcaneum as preserved.

is remarkable how this peculiar character has persisted from Triassic times until today. There are three phalanges in the second toe.

The third metatarsal is very much larger than the second and the phalanges considerably wider. There are also in this toe three phalanges. The fourth toe is a little larger than the third, and the fifth is almost as long as the fourth but more slender.

It is unnecessary to discuss here the question whether the bauria-morphs should be regarded as a distinct suborder from the therocephala-

lians, or, if Bauriamorpha be retained as a suborder, where the line dividing the two suborders should be drawn. Clearly the bauriamorphs are descended from a therocephalian ancestor, and only to be distinguished by a few characters

AMERICAN MUSEUM NOVITATES

Number 947

Published by
THE AMERICAN MUSEUM OF NATURAL HISTORY
New York City

Sept. 14, 1937

BIRDS COLLECTED DURING THE WHITNEY SOUTH SEA EXPEDITION. XXXVI¹

NOTES ON NEW GUINEA BIRDS. III

BY ERNST MAYR

This paper contains a continuation of my revisions of New Guinea genera, treating the families *Columbidae* and *Psittacidae*. Some of the results of my studies of these families have already been incorporated by me in the third volume of Peters', 'Checklist of Birds of the World,' when I read galley. Other studies were made at a more recent date and the results are published here for the first time. The measurements of all the wings were made with a rule, and the variable curvature of the wing was eliminated as much as possible. I am grateful to Dr. Junge for kind information on some material of the Leiden Museum.

Columbidae

Ptilinopus pulchellus pulchellus (Temminck)

Birds from Waigeu have the breast very light gray, birds from south-east New Guinea have it rather dark gray. But since the difference is not very marked and since topotypes from northwest New Guinea are about intermediate, it seems best not to name a new form.

Ptilinopus rivoli and forms

According to the literature, the two very similar forms *Ptilinopus prasinorrhous* and *miqueli* are to be considered as species, because they occur together on Jobi Island (Stresemann and Paludan, 1932, Novit. Zool., XXXVIII, pp. 205, 216, 242). This point of view is apparently not correct. *Ptilinopus rivoli prasinorrhous* is a bird which occurs in Geelvink Bay only on small islands, such as Numfor, Pulu Manim, Mios Korwar, Padaido (Traitors Is.), and possibly on some of the islets off the south coast of Jobi (Bruijn coll.). *Ptilinopus rivoli miqueli*, however, is the bird of the mainland of Jobi, where it occurs even in the lower mountains, up to an altitude of at least 450 m. (Stein coll.). There seems to be no objection to keeping both forms in one species.

¹ Previous papers in this series comprise American Museum Novitates, Nos. 115, 124, 149, 322, 337, 350, 356, 364, 365, 370, 419, 469, 486, 488, 489, 502, 504, 516, 520, 522, 531, 590, 609, 628, 651, 665, 666, 709, 714, 820, 828, 912, 915, 933 and 939.

Ptilinopus nainus nainus (Temminck)

An adult male from the Hydrographers Mts. (Eichhorn coll.) extends the range of this species considerably toward the east. The bird is very deep saturated green, not yellowish green, as all the other specimens from the south coast of southeast New Guinea in the Rothschild Collection. This is undoubtedly only due to a type of individual variation which also occurs in other species of this genus, as for example in *Ptilinopus aurantiifrons* and *Ptilinopus rivoli bellus*. I have before me specimens of *Ptilinopus aurantiifrons* from the Aru Islands which are as dark green as the darkest of a series of north New Guinea birds. I cannot submit to the opinion of Stresemann and Paludan (1935, Mitt. Zool. Mus. Berlin, XX, p. 451) that *novaeguineae* is a valid race.

Ptilinopus nainus minimus Stres. and Pal. (Waigeu) was described on the basis of its small size (♂ ad. 78, ♂ juv. 83, ♀ 78). The type of *nainus* from Lobo Bay measures 85.5, according to kind information of Dr. Junge. Additional specimens in the Leiden Museum measure as follows (Dr. Junge *in litt.*): Misol, ♂ 80, ♀ 79; "Papua" (v. Musschenbroek), ♂ 84, ♀ 79. Specimens in the Rothschild Collection from east New Guinea measure as follows: Mt. Gayata, ♂ 89, ♀ 89.5; Port Moresby and Aroa River, ♂ 87, 91.5, ♀ 86.5, 88; Hydrographer Mts., ♂ 87. It is probable that birds from eastern New Guinea average larger than such from west New Guinea. The birds of Misol must be referred to *minimus*.

Ducula concinna aru Salomonsen

This is a needless synonym of *Ducula concinna separata* Hartert (1896, Novit. Zool., III, p. 180.—Kei Islands) which was not even mentioned in the original description of *aru* (1934, Bull. Brit. Orn. Club, LIV, p. 87.—Aru Islands, in the Moluccas (sic!)). Incidentally, two of the three characters given by Salomonsen are invalid on account of individual variation, and the conspicuous grayness of the under parts of *separata*, on which Hartert based his description is not at all mentioned. It is possible, however, that Aru specimens average somewhat smaller than birds from the Kei Islands.

Ducula chalconota (Salvadori)

In 1901, Rothschild and Hartert called attention to the fact that Arfak birds were smaller than specimens from southeast New Guinea (Novit. Zool., VIII, p. 113). In 1931, I separated the east New Guinea form *smaragdina* on the basis of the more greenish, less reddish-purple

gloss of the upper parts (Mitt. Zool. Mus. Berlin, XVII, p. 706). Recently Stresemann and Paludan suggested that the green-backed form might have to be separated in two races, a small western one and a large eastern one (1936, Mitt. Zool. Mus. Berlin, XXI, p. 235).

The material of the Amer. Mus. measures as follows:

Arfak Mts.	♂ 196, 197, 201, no sex, 197, 204, 207, 218
Mt. Wondiwoi	♂ 213
Weyland Mts. (Stein and Shaw Mayer)	♂ 196, 208, ♀ 205, 208, 212
Orange Range (Mt. Goliath)	♂ 213, 217, ♀ 209
Mts. of southeast New Guinea	♂ 206, 208, 211, 214, 217, 220, 221, 223, 224, 230, 233 ♀ 211, 215, 215, 216, 218, 218, 220, 221
Mts. of Huon Peninsula (Mayr and Beck)	♂ 218, 219, 220, 221, 223, 223, 228, 231, 232 ♀ 213, 214, 219, 219, 225

These measurements show clearly that there is so much overlap that it seems inadvisable to separate the Weyland Mt. form.

***Macropygia amboinensis* (Linnaeus)**

The American Museum now possesses a great deal more material than I had seen in 1930 (see 1931, Mitt. Zool. Mus. Berlin, XVII, p. 707). The result of a study of these specimens shows that Hartert's and Rothschild's arrangement, as long ago as 1901, was essentially correct (1901, Novit. Zool., VIII, pp. 121-125).

***Macropygia amboinensis doreya* Bonaparte**

For characters see H. and R., *op. cit.*, p. 122. There is a considerable degree of individual variation in a series from the Vogelkop and it is, therefore, impossible to separate any races on the Aru Islands, the Western Papuan Islands and on Biak. Three adult males from the Aru Islands are heavily barred on the throat, rather deep rufous on the belly and very extensively vinaceous on the throat; the back is very dark and the skin on the hindneck mainly reddish; there is very little trace of gray on the head. Two Waigeu birds are quite different from each other, but both are heavily barred on the throat, rather dark above and rather pale on chin and upper throat; a single male from Biak (in poor condition) is fairly well barred on the throat, rather light on the abdomen, rather rufous on the back and has some gray on crown and hindneck; the gloss on the hindneck is greenish.

***Macropygia amboinensis maforensis* Salvadori**

Island of Numfor. A pale, strongly barred, and gray capped form (see R. and H., *op. cit.*, p. 123).

***Macropygia amboinensis kerstingi* (Reichenow)**

If a large series of this form is examined almost all the differences, as compared with *cinereiceps*, disappear (see Mayr, *loc. cit.*, p. 707). There is a tremendous amount of individual variation. Almost the only character which remains is the darker, more earth-brown coloration of the upper parts; there are fewer specimens with a pure gray crown and nape than in the D'Entrecasteaux Archipelago and more specimens with a strong rufous wash of forehead, throat and sides of face. Specimens from the type region (Astrolabe Bay and Ramu) are not as dark as birds from further west (Weyland, Mamberano and Cyclop Mts.).

***Macropygia amboinensis cinereiceps* Tristram**

The material collected by the Archbold-Rand Expedition shows clearly that *goldiei* cannot be maintained as a valid race, although there is a small average difference between birds from the D'Entrecasteaux Archipelago and southeast New Guinea (1937, Bull. Amer. Mus. Nat. Hist., LXXIII, p. 38).

***Macropygia amboinensis carteretia* Bonaparte**

I quite agree with Hartert that *huskeri* Neumann (New Hanover) is not a valid form (1925, Novit. Zool., XXXII, p. 119). The New Hanover specimens average slightly darker on the back and tail, but there are specimens on New Ireland, New Britain and Rook Island, which absolutely match the New Hanover birds. There are no other differences.

***Macropygia amboinensis admiralitatis*, new subspecies**

TYPE.—No. 334701, Amer. Mus. Nat. Hist.; ♂ ad.; Metawari, Manus, Admiralty Islands; March 3, 1934; Whitney S. S. Exp. (William F. Coultas).

Exceedingly similar to *M. amb. amboinensis* (L.), but distinctly darker above, particularly on the tail; shafts of the tail-feathers black, not brown; gloss on hind-neck green, not greenish purple; throat paler, less cinnamon; throat and breast more strongly washed with vinaceous; differs from all the other neighboring forms by the barring of the entire under parts, which includes in some specimens the outer under tail-coverts; differs from *meeki* through larger size and general rufous coloration.

Wing, ♂ 167-173 (168.8), tail 190-200; ♀, wing 159-162.

RANGE.—Manus, Admiralty Islands (Metawari, Petaiya, Pepitalai, Drabui).

Psittacidae**Probosciger aterrimus**

The geographical variation of this species in the New Guinea Region was until recently very insufficiently understood, as can be seen, for example, by Stresemann's account (1923, Arch. f. Naturgesch., LXXXIX, fasc. 8, pp. 54-55). The material collected in eastern New Guinea by the Whitney South Sea Expedition and by the Archbold-Rand New Guinea Expedition sheds a great deal of new light on the range of several of the forms.

(1) Probosciger aterrimus aterrimus (Gmelin)

This Australian race was discovered in south New Guinea by Archbold and Rand (1937, Bull. Amer. Mus. Nat. Hist., LXXII, p. 55). The wings of two males measure 353 and 373. This race is probably also found on the lower Eilanden and Noord Rivers, where van Oort measured a series as: 334-374.

(2) Probosciger aterrimus alecto (Temminck)

A series from the Western Papuan Islands is distinctly larger than *intermedius*, but smaller than *goliath*.

Wing, ♂ ad., 357, ♀ ad., 344, 348, 348, ♂ juv., 343, 349, 359, ♀ juv., 329, 334.

Tail, ♂ ad., 249, ♀ ad., 244, 245, 260, ♂ juv., 228, 250, 268, ♀ juv., 231, 248.

Culmen (sector), ♂ ad., 98, ♀ ad., 71, 76, 77, ♂ juv., 84, 84, ♀ juv. 73.

Immature birds are characterized by the whitish tip of the bill, by the barring of the under parts and by the more blackish plumage of the upper side.

(3) Probosciger aterrimus intermedius (Schlegel)

A series from the Aru Islands measures as follows:

Wing, ♂ ad., 332, 333, ♀ ad., 308, 314, ♀ imm., 315.

Tail, ♂ ad., 222, 223, ♀ ad., 218, 224, ♀ imm., 220.

Culmen, ♂ ad., 83, 87, ♀ ad., 69, 70, ♀ imm., 71, 73.

The immatures do not show any barring of the under parts.

(4) Probosciger aterrimus goliath (Kuhl)

This race, the type-locality of which Stresemann has fixed on the Onin Peninsula (*op. cit.*, p. 54), was known to occur in northwest New Guinea, west of Lobo Bay and the head of Geelvink Bay. A good series (6 ♂ ad., 3 ♀ ad.) from the south coast of southeast New Guinea cannot be separated from northwest New Guinea birds either by characters of coloration or by size.

I find the following measurements in a small series of northwest New Guinea birds:

Wing, ♂ ad., 391, 400, 400, ♀ ad., 353.

Tail, ♂ ad., 260, 266, 276, ♀ ad., 245.

Southeast New Guinea birds (south coast) measure as follows:

Wing, ♂ ad., 377, 385, 392, 393, 397, 407, ♀ ad., 355, 366, 387

Tail, ♂ ad., 248, 252, 254, 258, 274, 285, ♀ ad., 247, 253, 277.

The ranges of the northwest and southeast New Guinea population of *goliath* appear to be entirely separated in south New Guinea by the range of *aterrimus*. It is, however, quite possible that the true *aterrimus* is restricted to the coastal lowlands opposite Cape York, and that in the foothills of the central range, a population occurs, which is closer to *goliath* (although slightly smaller) than to *aterrimus*. If this is the case, the range of *goliath* would run continuously from northwest New Guinea along the southern slopes of the central chain to Milne Bay and Sariba Island in southeast New Guinea.

(5) *Probosciger aterrimus stenolophus* (van Oort)

This form with the narrow lanceolate crest-feathers is the most pronounced subspecies of this species. It extends much farther east than was hitherto recorded. A typical specimen was collected by the Whitney South Sea Expedition at the Bofu district, east of Collingwood Bay.

CACATUA BRISSON

The generic name *Cacatua* Brisson has been in use in the ornithological literature for a period of more than one hundred years. It is the name used in the 'Cat. Birds,' in Sharpe's 'Handlist,' in Salvadori's 'Orn. Pap. Mol.,' and in every single monograph of the parrots published during the last century. Recently Mathews replaced it by *Kakatoe* Cuvier which in my opinion is nothing but a *nomen nudum*. I shall continue to use the generic name *Cacatua* Brisson, until more valid reasons for its rejection have been advanced.

Cacatua galerita triton Temminck is the name that was applied for a long time for the birds of New Guinea, and the islands of its immediate vicinity (New Guinea Region). It is characterized by a yellow, upward curved crest, and by the bluish color of the naked circumocular space. In 1861, Rosenberg separated the birds of Misol (restricted type-locality) and Salawati as *macrolopha* on the basis of their much smaller size. Later authors combined the large Waigeu birds with *macrolopha* which was the cause of much confusion and gave Mathews the excuse to

name the Aru Islands birds *aruensis*. In 1888, Finsch listed some *Cacatua* from the Trobriand Islands as *trobriandi* without giving any characters. Lately (1923) Dr. Stresemann named the large population of the Huon Peninsula *kwalamkwalam*.

Peters (1937, 'Check-List of Birds,' pp. 173-174) admitted all these names and assigned definite ranges to every one of them. Certain discrepancies in the literature have caused me to reinvestigate the matter and have led me to conclusions which differ quite radically from the arrangement adopted by Peters.

I have personally measured wing, tail and culmen of 105 specimens, and have added the wing-measurements of 68 birds from the literature. The startling result is that in the 22 populations examined by me there is a gradual increase of size from the small Trobriand-Woodlark population to the giant birds of the Huon Peninsula. There are no sharp breaks anywhere and the small populations are scattered over the small islands east and west of New Guinea and in south New Guinea. There are no color differences between the birds of the various populations and if any races are recognized, the birds from Merauke, Aru Islands, Misol, Numfor, and the Louisiades would have to be one subspecies, separated from another to occur on the mainland of New Guinea, Waigeu, Jobi and Biak. This is a case quite similar to that found in *Podargus papuensis* (Amer. Mus. Novit., No. 939, p. 9) and *Psittorichas fulgidus* (see below, p. 9). To combine birds from different localities under one name, suggests that they are to be considered particularly closely related. This is, however, undoubtedly untrue in the case of the cockatoos. The only factor which joins the birds of the small populations together, is their small size. If we could investigate other characters, such as proportions, physiological properties, etc., we would probably arrive at quite a different arrangement. In view of all this, it is probably the best solution to list all the populations of white cockatoos in the New Guinea Region as *Cacatua galerita triton* Temminck without forgetting that they differ considerably in size.

Most collectors neglect to indicate on the labels the color of the naked area around the eye. It is supposed to be blue in *triton*, and white in the Australian *galerita*. A single specimen from Merauke (Leiden Museum) has this area described as "WHITE." It is possible that the small population of south New Guinea is a descendant of *galerita* and not of *triton*, and deserves to be separated subspecifically.

The wing-length of 22 populations of *Cacatua galerita triton* arranged according to size (measurements from the literature in italics):

- TROBRIAND-WOODLARK: ♂ 270, 283; ♀ 259, 260, 268, 273, 274, 276, 277.
 ARU ISLANDS: 260, 280, 280, 290¹; ♂ 286; ♀ 264, 274, 276, 279, 286.
 ST. AIGNAN: ♂ 277, 280, 284, 284; ♀ 270, 270.
 ROSSEL: ♂ 273, 273, 283, 284; ♀ 270, 272, 274, 274, 295.
 SUDEST: ♂ 268, 277, 297; ♀ 269, 276, 277, 278, 281, 282.
 MISOL: ♂ 275, 283; ♀ 274, 282.
 DARU-MERAUKE: 277¹; ♂ 283, 290; ♀ 260, 281, 282, 283, 286.
 D'ENTRECASTEAUX ARCH.: ♂ 284; ♀ 267, 290, 292.
 LOWER MAMBERANO: ♂ 286, 289, 290, 291, 300, 308; ♀ 275.
 NUMFOR: 280¹; ♂ 297; ♀ 288, 303, 303.
 NOORD RIVER: 300, 305¹; ♀ 285, 297, 298, 300.
 UTAKWA RIVER: etc.: ♂ 300, 305, 307, 312, 322; ♀ 285, 297, 298, 300.
 NORTH NEW GUINEA (SEPIK, etc.): ♂ 297, 302, 306, 310, 314, 318, 320; ♀ 302.
 WAIGEU: 303¹; ♂ 300, 320, 320; ♀ 309.
 VOGELKOP AND ARFAK: 310, 320¹; ♂ 304, 331; ♀ 308, 322, 325.
 ONIN PENINSULA: ♀ 310, 326.
 ASTROLABE BAY: 313, 319, 320, 320, 325, 327¹; ♂ 300, 309, 313, 313, 315, 326, 336; ♀ 311, 320, 328.
 JAPEN (JOBI): ♂ 298, 318, 321, 329; ♀ 310, 326, 331.
 NORTHERN SOUTHEAST NEW GUINEA: ♂ 314, 315, 316, 319, 325, 331; ♀ 319, 324, 333.
 SOUTHERN SOUTHEAST NEW GUINEA: 301, 310¹; ♂ 328, 335; ♀ 314, 316, 326, 328, 355.
 HUON PENINSULA: 306¹; ♂ 318, 334, 334, 338, 338, 347, 348, 354; ♀ 320, 321, 325, 330, 332, 339.
 BIAK ISLAND: ♂ 355.

I have prepared similar tables for the variation of the length of tail and culmen, but they do not differ very much from the variation of the wing-length and do not seem worth publishing. It may be mentioned that a good deal of the variation on New Guinea may be ascribed to vertical variation. Birds from the lower Mamberano are smaller than those from the upper, the same is true for the Fly River; birds from the mountains of the Vogelkop and of the Huon Peninsula average distinctly larger than specimens of the adjoining coasts. One of the principal reasons why the population of eastern New Guinea shows such large measurements is that there are practically no lowlands in eastern New Guinea, most of the terrain being covered by hills and mountains.

Psitttrichas fulgidus Lesson

There is no geographical variation of coloration in this species, but a great deal of variation of size.

I have already called attention to the heavy weight of Saruwaged birds in an earlier paper (1931, Mitt. Zool. Mus. Berlin, XVII, p. 702).

¹ Unsexed.

Birds from the Huon Peninsula also have longer wings than birds from other districts of New Guinea. The various populations in New Guinea measure as follows:

HUON PENINSULA (mountains): ♂ ad., wing 314, 319, 322, 335, 337, tail 191, 202, 205, culmen 41.5, 45, 45; ♀ ad., wing 312, 316, 322, 323, tail 190, 198, 198, culmen 38, 40, 42.

NORTH COAST OF SOUTHEAST NEW GUINEA (mountains): ♂ ad., wing 315 tail 196, culmen 42; ♀ ad., wing 318, tail 201, culmen 41.

SOUTH COAST OF SOUTHEAST NEW GUINEA (lowlands and mountains): ♂ ad., 305, 306, 311, 315, 317, 323, tail 181, 184, 186, 191, culmen 41, 42, 43, 45; ♀ ad., wing 302, 313, tail 179, 186, culmen 38, 40.

ASTROLABE BAY (lowlands?): ♂ ad., wing 315, tail 181, culmen 44; ♂ imm., wing 301, 310, tail 173, 184, culmen 38.5, 42; ♀ ad., wing 310, 315, tail 185, 194, culmen 38, 39.

EAST COAST OF GEELVINK BAY (lowlands): ♂ ad., wing 291, tail 165, culmen 41; ♀ ad., wing 273, 290, tail 158, 165, culmen 38.5, 39.

WONDIWOI MTS.: ♂ ad., wing 320, tail 178, culmen 40; ♀ ad., wing 290, tail 168, culmen 39; ♀ imm., wing 284, tail 176, culmen 38.

VOGELKOP (lower slopes): ♂ ad., wing 291, 292, 296, 303, 304, 304, 305, 305, 307, tail 162, 163, 173, 175, 175, 179, 180, 181, culmen 38.5, 38.5, 40, 40, 40.5, 41.5, 42; ♀ ad., wing 298, 303, 304, tail 166, 174, 180, culmen 38, 38, 38.5.

ARFAK MTS. (1500 m.): ♂ ad., wing 330, tail 185, culmen 40.

CENTRAL RANGE (SNOW MTS., etc.): ♂ ad., wing 284, 291, 296, tail 163, 188; ♀ ad., wing 272, 283, 289, tail 162, 162, 169, culmen 37.5.

These measurements of more than 50 specimens indicate that birds from the Huon Peninsula average larger and birds from the central Range and south New Guinea (Rand MS.) average smaller than typical birds from the Vogelkop. This variation is, however, much obscured by the fact that this species is very much subject to altitudinal variation. The differences in size of lowland and mountain birds from the same district is much bigger than that between mountain birds or lowland birds from different parts of New Guinea. Furthermore, the typical population from the lowlands of the Vogelkop (wing, ♂ 291-307) is just about intermediate in size between birds from south New Guinea and those from the Huon Peninsula (wing, ♂ 314-337). It seems better in view of these objections, not to split this species into size races.

ALISTERUS MATHEWS

Neumann considers all the forms in this genus to be subspecies of *amboinensis* in his review of the genus *Alisterus* (1929, Verh. VI. Intern. Ornith. Kongr., pp. 436-454). It seems preferable, however, to keep the Australian group, *scapularis*, as a separate species, and to group the remaining forms in two species: *amboinensis* and *chloropterus*. The

fact that Shaw Mayer collected both *Alisterus chloropterus wilhelminae* Og.-Grant and *Alisterus amboinensis dorsalis* Quoy and Gaimard at the same locality and at the same altitude in one of the ranges of the Weyland Mts., makes it advisable to keep the two specifically separated. (See Rothschild, 1936, Mitt. Zool. Mus. Berlin, XXI, p. 232.)

Alisterus amboinensis wiedenfeldi Neumann

According to the original description the only difference of this form, as compared with *moszkowskii* is that the female has the yellowish-green wing-band broader and more yellowish. A series of females from Humboldt Bay agrees quite well with this characterization except that the only immature female has no wing-band at all. The only female of *moszkowskii* in the Rothschild Collection (from the east coast of Geelvink Bay), which shows the wing-band vague and greenish, is also a juvenal, and it is quite possible that this character is only a sign of immaturity. I regard *wiedenfeldi* Neumann a synonym of *moszkowskii* until it is actually shown that the adult females of the western part of north New Guinea have a different color of the wing-band than females from the eastern part. (It may be said at this occasion that the immature male possesses a wing-band, although not as broad and not as clearly colored as the adult male; its back is, however, green as in the female.)

Alisterus amboinensis stresemanni Neumann

Neumann says of this form (*op. cit.*, p. 447): "I can find no differences between the series collected by Meek in the eastern [sic!] Snow Mts. and the type collected by Bürgers at the Lordberg (upper Sepik)." The Meek specimens show indeed quite well the characters on which *stresemanni* was named, but they were collected in August and October, 1910, when Meek was in the western Snow Mts. (Utakwa River). In fact the series collected by Meek is practically topotypical of *wilhelminae*. The alleged differences are entirely due to preparation. I have not seen the type of *stresemanni*, but it is clearly a synonym of *wilhelminae*, if it agrees with the Meek series, as Neumann says. A single adult male from the Weyland Mts., labeled *stresemanni*, agrees also perfectly with the Meek series. *A. c. wilhelminae* is very close to *callopterus*. More material from the upper Fly River will probably show that not even *wilhelminae* can be maintained.

Alisterus chloropterus chloropterus Ramsay

In 1931, I called attention to the large measurements of a series from the Saruwaged Mts. (1931, Mitt. Zool. Mus. Berlin, XVII, p. 702).

Not one of the birds of a series from southeast New Guinea reached the large size of the Huon Peninsula birds (Mayr and Rand, 1937, Bull. Amer. Mus. Nat. Hist., LXXIII, p. 58). Adult males from southeast New Guinea usually measure about 185-192, while Huon Peninsula birds usually have a wing of more than 200 mm. I have, however, examined one adult male from the Huon Peninsula (Beck coll.) with a wing of only 189 mm.

Many males of *chloropterus* from southeast New Guinea have forehead and loreal region washed with yellow, which I have never seen in a specimen from the Huon Peninsula. Adult females from southeast New Guinea have the upper side of the central tail-feathers largely bluish; it is greenish in all of the Huon Peninsula females examined by me.

All this indicates that the Huon Peninsula is inhabited by a population which is somewhat different from southeast New Guinea birds. More material must be collected at the Huon Peninsula before this population can be named.

AMERICAN MUSEUM NOVITATES

Number 948

Published by
THE AMERICAN MUSEUM OF NATURAL HISTORY
New York City

Sept. 27, 1937

BEES COLLECTED IN ARIZONA AND CALIFORNIA IN THE SPRING OF 1937

By T. D. A. COCKERELL

In March and April of the present year my wife and I collected in the region about Yuma, Arizona, and in Southern California. When we were at Yuma the early flowers were appearing, but the season throughout the southwest was very late (some said a month late), following the severe frosts which had proved so disastrous to the fruit industry. On the other hand, the unusual amount of moisture stimulated the growth of the desert plants, which were not injured by the cold. In the latter part of April the Mojave Desert, in particular, was a glorious sight, with its masses of variously colored flowers, the species differing remarkably in different parts of the area. The bee-fauna is extraordinarily rich, and every day's collecting yielded species new to science. In addition to those described below (the holotypes of which will be found in The American Museum of Natural History), we collected many other undescribed species, which had previously been taken by Mr. Timberlake, and are provided with manuscript names in his collection. We also obtained some which are likely to be new, but should be studied in connection with other materials; some of these have possibly been described in manuscript by Charles Michener. In a few cases the specimens, ascribed to known species, do not seem quite typical, and further consideration of them is deferred.

A brief excursion into Baja California (Mexico) from Yuma, and another across the boundary from Jacumba (alt. 2900 ft.) did not produce a single bee. From Yuma we made excursions into the dry country about the small settlements called Dublin and Dome and also across the Colorado River into the sandhill country of California, where our friend, Mrs. Leslie C. (Estelle) Dingess, has charge of a rural school. The pupils of this school (Andrade, Imperial County) took an interest in our work, and with their teacher have been collecting bees since we left. A consignment already received includes many good things, one here described as new, and three of Timberlake's unpublished species.

We were fortunate in being able to spend several days at Morongo, alt. 2600 ft., in a pass between the Mojave and Colorado Deserts, just

within the limits of San Bernardino County. This is about fifteen miles north of Palm Springs, and is a locality of unusual interest, with a rich flora. The larger vegetation includes an abundance of junipers (*Juniperus californica* Carrière) and stout yuccas (*Yucca mohavensis* Sargent).¹ The brilliant flowers of the beaver tail cactus (*Opuntia basilaris*) attract *Diadasia*. The peculiar chia (*Salvia columbariae* Benthham) was visited by an undescribed *Anthophora*. Species of *Phacelia*, especially the so-called wild heliotrope (*P. distans* Benthham) were attractive to bees. The yellow desert dandelion (*Malacothrix californica glabrata* Gray) was visited by some bees, including a new *Perdita* which will be published by Timberlake. The *Larrea* was not yet in flower. Species of *Gilia* (*G. inconspicua* (Smith) and *G. aurea decora* Gray, in particular) were abundant, but I obtained no bees from them. This seemed strange, as *Gilia calcarea* Jones, in Colorado, attracts many species of bees (see Novitates, No. 766). The *G. aurea decora* I could not identify, so I sent it to Dr. P. A. Munz. It is very abundant, and constant in its characters, and appears to me to be a distinct species. The true *G. aurea* not only has the flowers quite differently colored, but also a different, erect mode of growth, as figured by Brand.

We were greatly indebted to various people for their assistance and good fellowship, and the names of several will be noted as collectors. As in previous years, we owed the possibility of doing what we did mainly to Mr. and Mrs. P. H. Timberlake. Dr. and Mrs. John A. Comstock of Los Angeles, and Mr. and Mrs. John L. Sperry of Riverside, were with us in the Mojave Desert. Commander C. M. Dammers went with us to his favorite Gavilan locality,² where *Andrena zygaeni* (discovered by Dammers), one of the finest species of the genus, was flying about the *Zygadenus* in quantity. Dr. Comstock is preparing an illustrated work on the moths of California, a companion to his 'Butterflies of California,' published years ago. Commander Dammers has made many discoveries, of Lepidoptera, Mutillidae and bees. A splendid *Emphoropsis* which he found, and which is called after him, was described by Timberlake while I was at the Citrus Station. We collected both sexes of a

¹ I collected at night a specimen of the moth *Prodoxus pulverulentus* Riley (det. Busek). This has been recorded as breeding in *Yucca whipplei* Torrey, but at Morongo it must breed in *Y. mohavensis*, the only *Yucca* in the immediate vicinity.

² I venture to quote from a card received from Timberlake, dated May 31, 1937: "It has been cold and cloudy for about ten days, but today bright and warm, and I took Philip and went out to the Gavilan. Discovered a genus that I have never collected or even seen before. I believe it must be *Trachusa*, perhaps your *T. perdita*. Took quite a series on flowers of *Pentstemon antirrhinoides*, a large bush with yellow flowers. Males have a white face, female entirely black, both sexes with a narrow white band or fringe on apex of tergites. On the same flower a *Centris*, probably *C. hoffmanneggiae*. On the common *Eriogonum* (*E. fasciculatum*) a very small *Hesperapis* was common, but my specimens are apparently all males. This I think must be a new species, one that I have not taken before, unless it is the same as a small one from the Palm Springs region."

large new *Anthophora*, which is also to be dedicated to Dammers. But the principal work of Dammers has been on the life-histories of Lepidoptera, considerably over 200 species having been worked out and illustrated. The Sperrys have a very large collection of Lepidoptera, and have found some novelties. Mrs. Sperry specializes in the Noctuidae.

***Hypomacrotera andradensis*, new species**

FEMALE (type).—Like *H. subalpina* (Cockerell), described from New Mexico, but eyes red-brown to black, never green (pea-green in *H. subalpina*); face-marks reduced, those at sides of clypeus consisting of broad bands along the lateral thirds of the lower margin, remote from the dog-ear marks (in one specimen the face-marks are almost absent, nothing being left but two small spots at each side of clypeus). Wings longer and appreciably grayish. Abdomen variable but inclined to be darker apically, and often with a dusky spot in middle of first tergite.

MALE.—Eyes colored as in the female, never green (green in *H. subalpina*); clypeus with a light band along its lower margin, with a small oblique extension upward at each side; labrum black (largely pale in *H. subalpina*); mandibles black with the base pale (red beyond the base in *H. subalpina*); nervures darker than in *H. subalpina*.

California: Andrade, across the river from Yuma, Arizona, both sexes very numerous at desert mallow (*Sphaeralcea*); collected by Mrs. Estelle Dingess and her pupils of the Andrade school.

The name is intended to commemorate the admirable little school, the pupils of which have collected many bees. This insect was already known to Mr. P. H. Timberlake from Southern California, but he considered it the same as *H. subalpina*, judging by the published descriptions. The actual comparison of specimens shows several differences, but it may be that the insect should rank as a subspecies. True *H. subalpina* has been seen from Arizona, no special locality indicated.

In the description of *Hypomacrotera callops*, Cockerell and Porter, it is not stated which sex includes the holotype. I now so designate the male.

***Melitta wilmattae*, new species**

FEMALE.—Length about 15 mm., anterior wing 9.5 mm., width of head 4 mm.; black, with mainly white pubescence, abundant on head and thorax; a few dark hairs about ocelli, but none at sides of face; hair of thorax above very slightly flavescent or grayish, with a few black hairs interspersed on disc. Head somewhat broader than long; mandibles long and stout, very faintly reddish apically, with an inner tooth far from the end; malar space very short; antennae black, flagellum obscurely reddish beneath; flagellum short, truncate at apex; face with long hair; clypeus polished and shining; process of labrum prominent, feebly bilobed. Mesothorax densely covered with hair, except the posterior middle, which is shining; scutellum shining between the evident punctures, and with a median groove; area of metathorax dull,

rugose but not plicate, and with no median plica; posterior face of metathorax dull, very hairy; tegulae black, covered with hair in front. Wings grayish hyaline, with the usual venation of the genus; stigma very narrow, with a heavy dark margin and a light median streak; nervures black; basal nervure falling barely short of nervulus; second cubital cell parallel-sided, a little higher than broad, receiving first recurrent nervure at about the end of the first third; second cubital cell on marginal about the same as third. Legs with mainly white hair, but black at base of hind tibiae externally, brownish at end of front tibiae, seal brown on apical half of middle tibiae externally; hair on inner side of hind tibiae pale yellow; hair on inner side of basitarsi red. Abdomen rather parallel-sided, shining; first tergite with long white hair at sides, and broadly posteriorly; second to fourth tergites with entire, narrow but conspicuous, pure white apical hair-bands; fifth with long white hair, and dark hair in apical middle; hair of apex dark gray-brown; apical plate somewhat shining, without distinct sculpture.

Arizona: Dublin (near Yuma), one at flowers of *Sphaeralcea*, March 8, 1937 (Wilmatte P. Cockerell). Mr. Timberlake has never taken a *Melitta* in Southern California.

Related to *Melitta californica* Viereck, from Lower California, but without black hair at sides of face, and area of metathorax without a median plica. The stout inner tooth of the mandibles distinguishes it at once from *Dolichochile melittoides* Viereck, which should be called *Melitta* (*Dolichochile*) *melittoides*. I have a specimen of *M. melittoides* collected by Viereck at flowers of *Xolisma ligustrina* (Linnaeus), Beltsville, Maryland, July 5, 1917.

Nomada mckenziei Timberlake and Cockerell, new species

FEMALE (type).—Length 7.5 mm., anterior wing 6 mm.; head and thorax black, tubercles more or less reddish, clypeal margin sometimes reddish, and there are sometimes two red spots on the scutellum; hair of head and thorax dull whitish, varying to fulvescent. Head transverse, broader than long, the orbits converging below; mandibles simple, robust, clear red with the apex black; clypeus and adjoining parts of face dull, very densely and finely punctured; antennae long, reaching middle of scutellum, third joint about as long as fourth on upper side; scape red in front, or with only two red spots; flagellum stout, clear red, faintly or distinctly dusky above, with a black mark on inner side at base. Mesothorax and scutellum dull, finely punctured, the mesothorax more coarsely posteriorly, and with a median groove; scutellum not bigibbous; base of metathorax dull and granular; tegulae clear red. Wings dilute fuliginous; stigma and nervures black or nearly so; basal nervure going considerably basad of nervulus; second cubital cell nearly parallel-sided, receiving first recurrent nervure slightly beyond middle; third cubital cell greatly narrowed above. Legs bright red, with the coxae black, or hind coxae mainly red; trochanters black beneath; tibiae with the apical process long, extending outward. Abdomen broad, only moderately shining, deep red, without markings above or below, fifth tergite with an apical pale fringe.

MALE.—Length 9 mm., anterior wing 7 mm.; in most characters similar to female, but differing thus: pubescence of head and thorax very pale ochraceous, al-

most white, long and rather dense, especially on face, where it is subappressed and dense enough to conceal the surface; pubescence of abdomen fine, appressed and silky, becoming much larger around the apex, and forming an erect fringe on the apical margins of the ventral segments. Third antennal joint on its short side about two-fifths as long as fourth; apex of seventh tergite rounded, distinctly notched. Color similar, but mandibles on basal half, malar space and orbital margins opposite clypeus, yellow; scape entirely black; flagellum black above and dull ferruginous beneath; coxae and trochanters black as in female, as also front femora beneath, and middle and hind femora both behind and beneath; front and middle tibiae with a small black blotch behind; legs otherwise not so bright red as in female, and having the front tibiae anteriorly, the hind tibiae at apex, and the basitarsi, somewhat yellowish; abdomen with nearly the basal half of first tergite black.

California: The Gavilan, April 11, 1937 (Dammers) One female. This is the holotype, but the species was taken at the same locality by Commander Dammers, March 18, 1934 and March 12, 1935. The first specimen, collected also from the same place, was taken by H. L. McKenzie on March 11, 1933. All these are females; the only known male, from the same place, at flowers of *Eriogonum fasciculatum* Bentham, March 19, 1936, was taken by Timberlake. The species was named in manuscript by Timberlake after its discoverer. The above description of the female is by Cockerell, that of the male by Timberlake. This insect has been taken only at a place where *Andrena zygadeni* Cockerell is abundant at the same season, visiting flowers of *Zygadenus fremontii* Torrey. I suspect the *Nomada* is parasitic on this *Andrena*, but it must be said that other species of *Andrena* (*A. trifasciata* Timberlake and Cockerell, *A. blaisdelli* Cockerell and *A. opaciventris* Cockerell) also occur there. The *A. blaisdelli* was taken there by Dammers, March 6, at *Oenothera dentata*.

In my key to Californian *Nomada* (1903), *N. mckenziei* runs out near *N. elegantula* Cockerell, which has the abdomen differently marked, and is not very similar. In my key to Rocky Mountain species it runs out at *N. sidaeifloris* Cockerell, which has black legs. Many species have been described since these tables were published, but I cannot identify it with any of them.

Nomada edwardsii Cresson

California: Morongo, one female, April 20, 1937 (W. P. Cockerell).

It is surprising to find this species in a semidesert environment. The specimen differs from those collected at Olympia, Washington and Corvallis, Oregon, by having large yellow spots on the axillae. The yellow discal stripes on the mesothorax are well developed.

Bombomelecta edwardsii (Cresson)

California: Morongo, one female at flowers of *Phacelia*, April 22, 1937 (W. P. Cockerell).

This was determined by Timberlake as *B. edwardsii*, a species described by Cresson from a male labeled California. It nearly agrees with the description of *B. zygos* Viereck, based on a female from California; it appears to differ by having the abdomen only faintly bluish, and the mesothorax densely but coarsely punctured. Viereck suggested that his species might be the female of *B. edwardsii*. In the same general region, at Palm Springs, Mr. Timberlake has taken *B. larreae* Cockerell, at flowers of *Eriodictyon*.

I have also a female *B. edwardsii* from Los Angeles, collected long ago by Davidson.

Anthidium palmarum Cockerell

California: Morongo, April 19, 20, 1937, both sexes (T. D. A. and W. P. Cockerell); fifteen miles east of Palmdale, male at flowers of *Salvia carduacea* Bentham, April 26, 1937 (Mrs. J. A. Comstock).

I am placing the holotype of *A. palmarum* in the American Museum.

Anthidium cockerelli Schwarz

Arizona: Dublin, at flowers of *Encelia*, March 8, 1937 (Cockerell). A female, determined by Mr. Timberlake.

The species was described from the male. The female runs in the table given by Schwarz (Am. Mus. Novitates, No. 253) to 2, but differs by having tergites 1 to 4 four spotted, the spots subquadrate, or not at all linear; the fifth tergite lacks the lateral spots, the sixth has a pair of large spots, narrowly separated in middle. The mandibles are mainly light yellow, but the face is entirely black though there are two light spots above the eyes. The flagellum has a bright red band beneath. The scutellum has two spots, but the axillae are black.

Anthidium dammersi, new species

MALE (type).—Length about 9 mm., anterior wing 6.8 mm.; black, with the light markings pale yellow, lemon-yellow on abdomen; pubescence clear white, long and abundant on head and thorax. Eyes black or dark slate-color; face densely hairy; mandibles bidentate, with a cream-colored stripe reaching beyond middle; clypeus, and lateral marks filling space between clypeus and eye, yellow; a yellow spot above each eye; antennae entirely black. Thorax without light markings; tegulae yellow, with a large shining black spot. Wings hyaline, very faintly brownish apically; basal nerve going far basad of nervulus; outer recurrent interstitial. Anterior tibiae with a yellow stripe its whole length in front, or this may be broken in the middle; middle and hind tibiae spotted at base and apex; basitarsi light yellow.

Abdomen polished, first tergite with four spots, second to fifth with the spots united at sides by slender yellow lines, the outer spot on fifth nearly obsolete; sixth with two comma-like yellow marks; seventh all black; a sharp spine at each side of sixth tergite; seventh with apical lobes broad and pointed, the median spine rather short.

FEMALE.—Length about 9 mm. Mandibles with two large teeth and three minute ones; head entirely without light markings, except a yellow spot above each eye. Thorax without light markings. Tibiae black, with a small light spot at base; front and middle basitarsi pale, hind basitarsi black. Abdominal markings cream-color, sixth tergite entirely black, first four-spotted; ventral scopa white (full of bright orange pollen). The scutellum may have a pair of light marks.

California: nine miles north of Adelanto, Mojave Desert, April 25, ten males and two females (T. D. A. and W. P. Cockerell).

This species was discovered by Commander C. M. Dammers, and recognized as new by Mr. Timberlake, who asked me to describe it. Shortly after the discovery by Dammers, we went to the exact spot and got a good series. The bees were found only at flowers of *Astragalus fremontii* Gray. In the table by Schwarz (Novitates, No. 253) the male runs near *A. utahense* and *A. fontis*, or could possibly be sought near *A. tenuiflorae*. The female runs best to *A. tenuiflorae*. Compared with *A. tenuiflorae*, the lobes of the pygidium are more produced and angulate, the sinus between lobe and median spine deeper and narrower. The female differs from *A. tenuiflorae* in the form of the abdominal markings, which on tergites 2 to 4 take the form of narrow long clubs with a very slender base (not as long as the club), and a subcuneiform swelling at the outer or lateral end. The male *A. angulatum* Cockerell has pointed apical lobes, but the whole configuration of the tergite is different. *A. fontis* Cockerell has extensive yellow face-marks in the female. *A. utahense* Swenk is excluded for similar reasons. On the whole, I believe *A. dammersi* to be a Mojave Desert representative of *A. tenuiflorae* Cockerell, sufficiently distinct to stand as a species.

Along with *A. dammersi*, at the same flowers, we took *Osmia titusi* Cockerell and *O. timberlakei* Cockerell.

Xenoglossodes arizonica, new species

MALE.—Length about 13 mm., antennae about 9 mm.; black, including the tarsi. Mandibles all black, but the convex shining clypeus very pale yellow, the yellow deeply notched on each side, while the labrum is white, with a large dark mark at each extreme side; eyes black or nearly so; the light pubescence is white, a little grayish, but not at all fulvous, dorsally; facial quadrangle about as broad as long; third antennal joint very short. Mesothorax very hairy, dull, posteriorly shining; tegulae dark, densely covered with hair. Front and middle tarsi very long; spurs very pale, hind spur not modified; the hair on inner side of hind basitarsi pale, not brightly colored. Wings hyaline, with dark nervures, basal nervure falling short of

nervulus. Abdomen with long hair at base, otherwise covered with short pale tomentum, leaving the broad apical margins of second and third tergite exposed and intense black, the fourth has a much narrower black margin, the sixth is densely white-tomentose apically, apex of venter sharply pointed; some dark brown hair on under side of abdomen.

Arizona: West of Dome (Yuma County), at flowers of *Lycium*, March 7, 1937, four males (Cockerell, Hobart, Dingess).

Readily distinguished from *Tetralonia lycii* Cockerell (New Mexico) by the light hair at end of abdomen, and the short third antennal joint. In my key it falls nearest to *T. frater* (Cresson), described from Colorado, but differs in the pubescence of abdomen and legs. It is quite distinct from all the species taken by Timberlake in California.

I described this species as a *Tetralonia*, having no doubt that it belonged to that genus. However, Timberlake, suspecting something, examined the genitalia and mouth-parts, and reports (litt. May 20, 1937), "I have extracted the genitalia of the specimen you gave me, and find them to be of the *Xenoglossodes* type. Also, the maxillary palpi are five-jointed instead of six."

In *Xenoglossodes* it is perhaps as near to *X. lippiae* Cockerell as to anything, but very distinct by the polished cream-colored clypeus, and the pattern of the abdomen.

Spinoliella puellae Cockerell

California: Morongo, at flowers of *Malacothrix californica glabrata* Gray, males, April 21 (Cockerell).

Diadasia opuntiae (Cockerell)

California: Morongo, at flowers of *Opuntia basilaris* Engelmänn and Bigelow, April 22 (Cockerell); on road to Morongo, but in Riverside County, at flowers of *Echinocactus acanthodes* Lemaire, April 29 (W. P. Cockerell).

Centris pallida Fox

California: Andrade, at flowers of *Cercidium floridum* Benthām, April 19, 1937 (Louis Southwick).

Arizona: Yuma, spring of 1937 (R. M. Young).

Centris lanosa Cresson

California: Andrade, at flowers of *Cercidium floridum*, April 19 (Louis Southwick). Male.

It was thought that this might be the undescribed male of *C. cockerelli* Fox, but I cannot separate it from *C. lanosa*.

Anthophora hololeuca Cockerell

California: Andrade, at flowers of purple sage, April 19 (Estelle Dingess).

Described from Angel de la Guardia Island, in the Gulf of California, but Timberlake finds it common in the desert of Southern California.

Anthophora neglecta Timberlake and Cockerell

California: Morongo, April 20 (W. P. Cockerell); near Adelanto, Mojave Desert, April 26, females, eyes black in life (John L. Sperry).

A variety of the female, with yellowish hair on thorax above, comes from Phelan, April 26 (Cockerell).

Anthophora texana Cresson

California: Andrade, at flowers of *Lycium*, April 19, female (B. Ball and R. L. Davis).

The eyes are much darker than in one from Mesilla, New Mexico.

Anthophora (Micranthophora) columbariae Timberlake and Cockerell,
new species

MALE (type).—Length about 9 mm., anterior wing 5 mm.; black, the flagellum obscurely reddish beneath, clypeus with a narrow pale apical band, labrum very pale yellow with a pair of black spots, mandibles with the basal half pale yellow, the tarsi reddened apically, the tegulae translucent pale testaceous; eyes greenish, becoming blackish in dried specimens. Discs of mesothorax and scutellum highly polished; area of metathorax dull, with a shining margin and with a strong groove in middle; middle tarsi long, but not remarkably so. The wings hyaline with dark nervures, basal nervure falling a little short of nervulus; second cubital cell receiving first recurrent nervure at middle. Hair of head and thorax very abundant, pure white, on face very dense, entirely covering the surface; tibiae and basitarsi with much white hair, hind basitarsi with red hair on inner side; abdomen with long white hair on basal part of first tergite; tergites 1 to 4 with fine white tomentum, lacking basally, so that there are more or less evident (according to extension of abdomen) black basal bands; fifth tergite without white tomentum, the margin broadly more or less pallid; sixth similar, with a little white hair at sides; apex with a pair of rather widely separated red divergent teeth.

FEMALE.—Head broad, clypeus with a shining middle line, and a transverse very pale yellowish apical band, which is angular above in middle; labrum and mandibles marked as in male. Vertex with long black hairs; thorax above with hair grayish, strongly mixed with black; hair on inner side of hind basitarsi appearing nearly black in one view, red in another; tergites 1 to 4 covered with fine white tomentum, fifth black, abruptly contrasting.

California: Morongo, April 20–22, 1937 (Cockerell, W. P. Cockerell). Many specimens, flying around *Salvia columbariae* Benth.

In the table in Trans. Amer. Ent. Soc., XXXII (1906), pp. 66–67, the male runs out at 8, on account of the dark antennae, combined with

dark fifth tergite. The female runs nearest to *A. anstrutheri* Cockerell, but that is larger, with yellowish hair on abdomen, and only a triangular black patch on fifth tergite; also, the clypeus has a broad yellow band, and there is a supraclypeal mark. There is no close affinity with any of the species described in Proc. Calif. Acad. Sci., XII (1923), pp. 79-83, or with other recently described forms.

The following specimens, in the Timberlake collection, are to be considered paratypes:

The Gavilan, California, 1 ♂, March 27, 1933 (Dammers). The first specimen seen by Timberlake.

Deep Creek, California, May 5, 1936 (Timberlake), on *Eriodictyon trichocalyx*. This is at junction of Deep Creek and Mojave River.

Mojave River, near Deep Creek, on *Salazaria mexicana* Torrey, May 16, 1937 (Timberlake). This had collected two kinds of pollen, including salmon-colored pollen from *Salvia carduacea*. One ♀.

One and one-half miles west of Perris, California, 1 ♀, on *Salvia columbariae*, April 18, 1937 (Timberlake).

Morongo, male on *Cryptantha*, female on ground, April 22, 1937 (Timberlake); also six taken at Morongo by T. D. A. and W. P. Cockerell.

"The females are all very similar, except that the Perris specimen has whitish band on clypeus narrower than usual. All my males, except the four collected by Mrs. Cockerell, lack the whitish band on clypeus (beneath the white hair). The male from Deep Creek has the flagellum strongly fulvous-reddened, but irregularly and not uniformly so as to each antenna. It also has a large red streak on hind femora both in front and behind." (Timberlake.)

Alcidamea biscutellae Cockerell

Arizona: Yuma, spring of 1937 (Ralph M. Young). Both sexes. New to Arizona.

There is a large thorn-like projection at base of male abdomen beneath, the point directed downward and forward. This was overlooked in the original description (Ann. Mag. Nat. Hist., April, 1897, p. 400). For the female, see Pan-Pacific Entomologist, April, 1935, p. 51.

Chlorosmia lawae Michener

California: Morongo, at flowers of *Lupinus*, April 22, female (W. P. Cockerell).

Osmia clarescens Cockerell

California: Morongo, at flowers of *Lupinus*, April 20, female (W. P. Cockerell).

Osmia gaudiosa Cockerell

California: Morongo, April 20, female (Cockerell).

This has the ventral scopa black. Many years ago Mrs. M. Ellis found in Colorado what I took for the female of *O. gaudiosa*, and the scopa was reddish white. I now doubt whether I correctly associated the sexes. Timberlake writes concerning *O. gaudiosa*: "I have two males from Boulder, but no females. I have compared the California *gaudiosa* again and find no distinctive characters, although the flagellum is darker. My females vary from green to blue and are generally decidedly bluer than the males, which seem to be always green." (May 12, 1937.)

Osmia morongana, new species

FEMALE.—Length 7.5 mm., anterior wing 6 mm., width of abdomen about 2.7 mm.; robust, blue-green; the antennae, tegulae and legs black. Hair on head and thorax long and mostly white, but black on middle of face (long and white at sides of face), mainly black on mesopleura, but some white hair in front, an admixture of long black hairs on vertex and thoracic dorsum. Tongue bright orange-ferruginous (in various related species it is black or nearly so). Mandibles broad, strongly tridentate; apical half of clypeus black, but clypeal margin straight and even, somewhat pallid; a shining spot at upper margin of clypeus; front dull, appearing granular from the very dense punctures, dark green; vertex shining between the punctures. Mesothorax dull and very densely punctured, posteriorly shining between the punctures; scutellum with a shining band in middle; sides of metathorax with white hair; mesopleura densely punctured. Wings dusky; distance of first recurrent nervure from base of second cubital cell almost or quite equal to length of first intercubitus. Legs with scanty pale hair, brownish on inner side of the broad hind basitarsi; the hind basitarsi, viewed in an oblique light, appear to have a ridge down the middle; spurs black. Abdomen short and broad, the first three tergites shining, the others dull; ventral scopa wholly black.

California: Morongo, April 20, at flowers of *Lupinus* (W. P. Cockerell). In my table of *Osmia* (University of Colorado Studies, XVI, 1928) it runs to 62 but, as the hair of pleura is partly light, it might be sought under 63, where it runs out at *O. phaceliae*, the front not being brightly colored. But it goes more correctly under 71, and there runs out near *O. hypoleuca*, or could possibly go near *O. senior*, differing by the tridentate mandibles. In the Sandhouse table of Californian *Osmia* it runs out at 25. This species and the next were unknown to Timberlake, but I refrained from describing them, supposing it likely that Charles Michener had described them in manuscript. Recently he visited me, and on examining them found that this was not the case.

***Osmia lupinicola*, new species**

FEMALE.—Length about 8 mm., anterior wing 6 mm.; robust, the head and thorax dull bluish green, the abdomen shining yellowish green; mandibles, antennae (flagellum very faintly brownish beneath), tegulae and legs black. Hair of head and thorax abundant, white, some long dusky hairs on scutellum, not conspicuous; when the face is seen from above, the hair at sides appears brilliant pure white, that in clypeal region distinctly grayish. Mandibles strongly tridentate; clypeal margin simple; front very dull and densely punctured; vertex little shining, but a polished spot laterad of each lateral ocellus. Mesothorax dull and densely punctured; scutellum very hairy, yellowish, contrasting with mesothorax; base of metathorax dull. Wings dusky; first recurrent nervure about as far from base of second cubital cell as length of intercubitus. Legs with much short white hair, slightly brownish on inner side of hind tarsi; spurs black. Abdomen broad, shining, the apical part dull; tergites with inconspicuous thin white hair-bands, weak or failing in middle, the sixth densely covered with white hair; ventral scopa shining white at sides, blackish or dark gray in middle.

California: Morongo, April 20, at flowers of *Lupinus* (W. P. Cockerell). In my table it runs out at *O. coloradella*; the tibiae not being blue. In the Sandhouse table it goes near *O. seclusa*, but that is larger with entirely black ventral scopa, and quadridentate mandibles.

***Xylocopa arizonensis* Cresson**

Arizona: Yuma, March (U. L. Smith).

***Ceratina arizonensis* Cockerell**

Arizona: Yuma, March, in hollow twig (Geo. Edwards).

***Halictus sisymbrii* Cockerell**

California: Perris, at flowers of *Oenothera bistorta veitchiana* Hooker, April 11, female (W. P. Cockerell).

***Halictus punctatoventris* Crawford**

California: Riverside, at flowers of *Eschscholtzia* in garden, April 18 (Cockerell); Phelan, April 26 (Cockerell). These are females, and were determined by Timberlake.

***Augochlora pomoniella* Cockerell**

California: Morongo, April 20, female (Cockerell).

***Agapostemon angelicus* Cockerell**

Arizona: Dublin, March 8, females (T. D. A. and W. P. Cockerell).

California: Andrade, at *Sphaeralcea*, March 29, female (Estelle Dingess).

Agapostemon melliventris Cresson

Arizona: Yuma, spring of 1937 (R. M. Young). Female, the femora red at base, not black as in Cresson's type.

Andrena enceliarum, new species

MALE.—Length about 10 mm., anterior wing 8.5 mm., width of abdomen about 3.5 mm.; entirely black, including mandibles and tegulae, the flagellum very faintly brownish beneath. Head subcircular seen from in front, inner orbits nearly parallel; mandibles ordinary, rufescent at tips; process of labrum broadly truncate; malar space linear; third antennal joint a little longer than fourth; clypeus prominent, convex, shining, with distinct well-separated punctures; front dull, but a shining region above tops of eyes; cheeks ordinary, with much long hair; head and thorax with very long, outstanding, rather dull white hair. Mesothorax dull, very minutely punctured, moderately shining on disc; scutellum shining, with fine punctures, its anterior margin gibbous; area of metathorax poorly defined, dull and granular, the metathorax covered with long hairs. Wings hyaline, a little dusky at apex; stigma slender but well developed, rusty black; nervures dark brown; basal nervure falling short of nervulus; second cubital cell narrowed above, receiving recurrent nervure beyond middle; third cubital on marginal about equal to second. Legs black, with pale hair, slightly yellowish on inner side of tarsi. Abdomen very broad, oval, first tergite shining, the others with margins broadly polished; first tergite with thin whitish hair on sides and posteriorly; second to fifth with very thin inconspicuous bands, interrupted on first two; apex with dense white hair, apical plate emarginate; venter with four thin grayish-white bands; tergites at extreme sides strongly developed, overlapping venter, the sides of the abdomen, seen from above, showing strong constrictions.

Arizona: Dublin, at flowers of *Encelia*, March 7, 1937 (Cockerell).

A peculiar species, known by the broad shining abdomen with tergites gibbous at sides, and the gibbous scutellum, with very deep scutello-mesothoracic suture. In my manuscript table it runs near *A. occidentalis* (Cockerell), which is entirely different, the cheeks with a sharp crest behind. But except for the slightly shorter wings, it runs near *A. argentiniæ* (Cockerell), to which it is more nearly allied, differing conspicuously by the smaller head, with convex, polished, clypeus, the dark stigma, the wings not brown and other characters. The cheeks are subangulate behind, but very hairy, and the angle is about opposite the middle of the eye, so that in Viereck's table of northwestern species it it would run nearest to *A. decussata* Viereck, from Pullman, Washington, but in that species (which is smaller) the second cubital cell receives the recurrent nervure before the middle.

Andrena prunorum arizonensis (Viereck and Cockerell)

Arizona: Gila River bridge, near Dome, at flowers of *Salix*, March 7, 1937 (Cockerell). Three males were taken; two with the typical dark abdomen and black legs, and one with the abdomen broadly

ringed with bright red on first four tergites, and the legs red except at base. All have the clypeus light yellow with two black dots.

This was described from the female, as a distinct species, but has later been held to be a form of *A. prunorum* Cockerell. These males differ from the *A. prunorum* by the dark brown tegulae, the distinct bluish tint of the abdomen, and the considerably narrower apical depression of second tergite. Although the dark color of the abdomen is not constant, a recognizable subspecies is indicated.

Very closely allied to this, with the dark tegulae and narrow depression of first tergite, is *A. fracta* Casad and Cockerell. The male *A. fracta* is smaller than that of *A. arizonensis*, and the abdomen is not bluish.

***Andrena flandersi* Timberlake**

California: Morongo, 2600 ft., April 22, 1937 (Cockerell). Determined by Timberlake.

***Andrena mimetica falli* Cockerell**

California: Morongo, one female at flowers of *Isomeris arborea angustata* Parish, April 21, 1937 (Cockerell).

Concerning this form, see a paper by E. Gorton Linsley, shortly to be published.

***Andrena (Pterandrena) plumifera* Cockerell**

California: Phelan, April 26, 1937 (J. L. Sperry). The hair of the thorax above is pale, not strongly fulvous as in the type, but the species is the same.

***Diandrena sperryi*, new species**

FEMALE.—Length 7 mm., anterior wing 5 mm.; robust, dark green, the mesopleura and metathorax bluer; hair of head and thorax abundant, grayish white; eyes black. Head large, the facial quadrangle broader than long; mandibles black, long and curved, simple; process of labrum narrow, highly polished, emarginate at end but this is not apparent when seen from above; clypeus convex, shining, with a smooth median line, and not very dense strong punctures; facial foveae dull white, rather narrow, occupying less than half the distance between antenna and orbit; vertex mainly dull, but a shining pit laterad of each lateral ocellus; antennae black, the flagellum rufescent beneath apically. Mesothorax shining on disc, finely punctured; scutellum rather coarsely and densely punctured, but shining in middle; area of metathorax well defined, triangular, with delicate but well-defined plicae; tegulae very dark, almost black. Wings hyaline; stigma large, dilute reddish with a dark border; second cubital cell receiving first recurrent nervure at a distance from base at least as great as length of first intercubitus. Legs black, with pale hair, hind knees dark; tibial scopa of mostly long simple hairs, but those on dorsal side plumose.¹

¹ The pollen carried is globular, spinulose, yellow, evidently from a species of Compositae.

Abdomen broad, polished, weakly punctured, with only feeble indications of bands, the narrow depressed margins pallid; hair at apex pale, a little stained with brownish; venter practically black. There is no black hair at sides of face.

California: near Adelanto, in the Mojave Desert, April 26, 1937 (Cockerell). A second specimen, taken on the same day at Phelan, is considerably smaller and less robust, but is I think surely the same species. Mr. Timberlake examined these specimens, and found them to be different from all those in his collection. The following key separates this from several superficially similar small forms:

- 1.—Abdomen olive-green, not polished, with three very distinct white hair-bands
beatula Cockerell.
 Abdomen not thus olive-green and banded.....2.
- 2.—Abdomen entirely dull, dark bluish; stigma solid dark brown.
cyanosoma Cockerell.
 Abdomen evidently shining.....3.
- 3.—Thorax dark blue; stigma large, solid reddish brown.....*marinensis* Cockerell.
 Thorax green4.
- 4.—Stigma pale reddish with a dark margin; area of metathorax reticulate-plicate,
 the metathorax on each side of the area reticulate....*sperryi*, new species.
 Stigma solid brown.....5.
- 5.—Wings clear hyaline (on *Calandrinia*)... new species Timberlake, Ms. (male).
 Wings dusky.....6.
- 6.—Tergites with broad pallid margins.....*puthua* Cockerell.
 Tergites without pallid margins new species, Timberlake Ms. (female).

D. beatula is taken by Timberlake at Riverside on flowers of *Baeria gracilis* (De Candolle). I have named this species after the ardent lepidopterist, J. L. Sperry, who was with me when it was found. Timberlake finds he can divide *Diandrena* into two groups one visiting *Onagraceae*, the other the spring *Compositae*. In the former the scopa is composed entirely of long simple hairs. Up to the present time 19 species of *Diandrena* have been described, all but four coming from California.

Parandrena papagorum (Viereck and Cockerell)

Arizona: Gila River bridge, near Dome, at flowers of *Salix*, March 7, 1937, females (Cockerell, Hobart, Dingess). This peculiar species was described under *Andrena*; Timberlake refers it to *Parandrena*, which seems to be the best disposition of it.

Mr. Timberlake writes that he has taken 398 species of bees at Riverside. This must be by far the greatest number known from any one locality. Robertson, collecting intensively for many years about Carlinville, Illinois, got 297 species.

AMERICAN MUSEUM NOVITATES

Number 949

Published by
THE AMERICAN MUSEUM OF NATURAL HISTORY
New York City

Sept. 27, 1937

SIBERIAN BEES OF THE GENERA *HALICTUS*, *SPHECODES*, AND *HYLAEUS*

By T. D. A. COCKERELL

The holotypes of the new forms described will be found in The American Museum of Natural History.

Halictus (Chloralictus) angaricus, new species

FEMALE.—Length about or slightly over 5 mm., anterior wing 3.8 mm.; head, thorax and abdomen green. Head a little longer than broad, finely punctured, blue-green, including the dullish, densely punctured supraclypeal area; clypeus with the upper part golden green, suffused with coppery, but more than the lower half swollen, black; mandibles rufescent in middle; flagellum red beneath except at base; hair of head and thorax scanty, rather dull white. Mesothorax mostly dull, but sides of disc shining, the whole surface closely and strongly punctured; the thorax above is yellowish green, not bluish green; scutellum shining on disc; metathorax dull dark bluish, the area, as seen under a lens, crescentic, appearing granular; sides of metathorax bluish green, pleura more yellowish green; tegulae small, clear red. Wings hyaline, slightly dusky, stigma pale yellowish, nervures very pale, first recurrent meeting second intercubitus. Legs mainly black, but knees, tibiae at apex, and the tarsi pale red, hind basitarsi with a dusky cloud. Abdomen yellowish green, shining, finely punctured, the margins of the tergites pallid; in the type the extreme base of third tergite is exposed, and is reddish; the abdomen is finely pruinose-pubescent, but without hair-bands. Microscopic characters: front excessively densely punctured; tegulae not punctured; postscutellum large, dull and granular; area of metathorax with very weak irregular plicae, more or less connected by a very fine reticulation.

Siberia: Ust Balei, on the Angara River, July (Cockerell).

By the sculpture of the mesothorax this resembles the German *H. aeneidorsum* Alfken, which is larger, with the front half of clypeus blue, and the mesonotum thickly hairy. From *H. smeathmanellus* Kirby it is easily known by its small size, and the strongly and closely punctured mesothorax. Compared with *H. mayacensis* Cockerell it is considerably smaller, with shorter head.

Halictus (Evyllaesus) baleicus, new species

FEMALE (type).—Length about 7 mm., anterior wing 5 mm.; black, with the flagellum very obscurely brownish beneath, and the hind margins of the tergites narrowly pallid, slightly rufescent; hair of head and thorax moderately abundant, dull whitish. Head seen from in front broad, approximately circular; clypeus highly

polished, with strong, well-separated punctures; supraclypeal area shining, punctured; front dull. Disc of mesothorax shining, with distinctly separated punctures; scutellum with two shining areas, separated by a broad dull band; area of metathorax large, crescentic, coarsely rugulose, sharply defined behind; posterior truncation sharply defined at sides; tegulae not punctured, shining dark brown. Wings hyaline, faintly yellowish, stigma large, pale yellowish; nervures very pale, first recurrent joining apical corner of second cubital cell. Legs black, with pale hair, a tuft of bright copper red at end of the long hind basitarsi; hind spur with five stout, not very long, oblique spines. Abdomen polished, the punctures very weak; tergites with basal bands of grayish tomentum, broad on third, but much narrowed in middle, thin poorly defined apical bands on third and fourth; hair at extreme apex yellowish.

MALE.—With very long antennae, and cylindrical abdomen, identical in nearly all respects with *H. laticeps* Schenck. The following key separates the closely allied species.

1.—Mesonotum entirely dull, flagellum red beneath (Frankfurt, Germany).

fulvicornis Kirby.

Mesonotum distinctly shining.....2.

2.—Area of metathorax large; abdomen more robust, very black; flagellum all dark, or partly dusky reddish beneath.....*baleicus*, new species.

Area of metathorax relatively small.....3.

3.—Flagellum red beneath (Német Bogsan, Hungary).....*laticeps* Schenck.

Flagellum all dark.....*mendax* Alfken (*affinis* Schenck).

Blüthgen has stated that *H. mendax* is not a valid species, as distinct from *H. laticeps*. My male *H. mendax* was determined by Strand, and is without locality.

Siberia: Ust Balei (type locality), July, five females and four males (Cockerell); Smolenschina, Aug. 17, one male (Cockerell).

A female was sent, several years ago, to Blüthgen, who wrote that it was apparently new, but near *H. fulvicornis* Kirby. The strongly but sparsely punctured disc of mesonotum places it rather with *H. laticeps* and *H. mendax*, and the male also seems nearer to these species. In the male *H. laticeps*, the front is broader, so that the inner orbits converge more rapidly below. This is not identical with any species from the Maritime Province of Siberia. It is distinguished from *H. sulcatulus* Cockerell by the broader head, and abundant white hair at sides of face. From *H. tutihensis* Cockerell it differs by the coarser and denser sculpture of area of metathorax, and the larger, paler wings. Another related species is *H. sibiriacus* Blüthgen, based on a female, 7.5 mm. long, from the Radsoskowsky collection, collected in East Siberia.

H. fulvicornis Kirby has been recorded from Irkutsk (Morawitz).

Halictus (Evyllaeus) minutulus, speculiferus, new subspecies

FEMALE.—Agreeing with *H. minutulus* Schenck, except that the basal area of metathorax is very large, shining, with very strong plicae at base, but on the apical

half these are represented only by fine lines. Head approximately round seen from in front; apical part of flagellum obscurely reddish beneath. Mesothorax shining, with well-separated punctures, the sculpture between the punctures indistinct; tegulae dark reddish brown. Wings hyaline with a large pale yellow stigma, and very pale nervures; apical truncation of metathorax shining, sharply defined all round. Legs black, including tarsi (*H. semilaevis* Blüthgen and *H. sibiriacus* Blüthgen have red-brown tarsi); hind spur with three oblique, rather slender spines, and a rudimentary fourth one (*H. minutulus* spur is quite the same). Abdomen shining, without hair-bands or spots, but apical part hoary with pale hair; hind margins of tergites rather obscurely rufescent. Length about 6 mm., anterior wing about 4.5 mm.

Siberia: Smolenschina, Aug. 21 (Cockerell).

H. minutulus varies in Europe; Schenck appears to have had no less than five names for it. I made a little table of some related species (females) as follows:

- 1.—Polished band along inner orbits very distinct; plicae of metathoracic area strong, reaching margin. *puncticollis* Morawitz.
Polished band along inner orbits not evident; plicae of metathoracic area weaker. 2.
- 2.—Larger, anterior wing nearly 6 mm.; hind tibiae with dense yellowish hair.

laevis Kirby.

Smaller, anterior wing about 4.5 mm.; hind tibiae with thinner grayish-white hair.
minutulus Schenck.

The Smolenschina bee goes exactly to *H. minutulus* in this table. It is not any of the species I described from the Maritime Province. Compared with *H. brachycephalus* Cockerell it has the metathoracic area much larger and more shining. *H. perplexans* Cockerell and *H. trichorhinus* Cockerell have the abdomen quite different.

Halictus (Curtisapis) *alinensis* Cockerell

Siberia: Smolenschina, Aug. 17 (Cockerell).

The face is perceptibly broader than in the typical form, which comes from the Maritime Province of Siberia.

Sphecodes angarensis, new species

FEMALE.—Length about 9 mm., anterior wing 7 mm.; robust, the head and thorax with scanty pale hair; head, thorax and legs black. Head very broad, transverse, shaped nearly as in *S. intermedius* Blüthgen, but not so flattened above. Mandibles broad, black, faintly reddish apically, the inner tooth small and obtuse; labrum polished, with a transverse groove; clypeus very coarsely punctured; fourth antennal joint very short, broader than long, transverse, shorter than third when viewed from below; fifth longer than fourth, only a little broader than long; antennae black, the flagellum very faintly brownish beneath; vertex strongly and closely punctured, no crest behind ocelli. Mesothorax and scutellum highly polished, with very coarse irregular punctures, mesothorax with a median depression; area of metathorax coarsely and densely plicate; mesopleura coarsely rugosopunctate; tegulae

dark in front, clear reddish brown behind. Wings reddish fuliginous, very strongly colored; stigma very dark reddish; basal nervure falling far short of nervulus; second cubital cell high and narrow, receiving first recurrent nervure at about the beginning of its last third (in *S. sibiricus* the recurrent meets the second intercubitus); hind wing with ten hooks (8 in *S. sibiricus*). Hair on inner side of hind basitarsi slightly yellowish; spurs dull red; hind femora swollen basally (stouter than in *S. sibiricus*). Abdomen with the first three tergites bright red, the following black; first tergite (as seen under microscope) with widely spaced shallow piliferous punctures, and very minute ones scattered between, the apical part with only small very widely spaced punctures; second tergite punctured like first, third with the punctures much smaller.

Siberia: Ust Balei, on the Angara River, July (Cockerell).

At first sight, this could be taken for *S. sibiricus* Cockerell, which has a similar broad head; but it is easily separated from *S. sibiricus* by the polished, sparsely punctured discs of mesothorax and scutellum and the more finely sculptured area of metathorax. It also lacks the broad black band seen on the third tergite of *S. sibiricus*. In the European fauna, *S. spinulosus* v. Hagens is a similar species, but with a longer head, more closely punctured mesothorax, and a groove in middle of scutellum. In *S. spinulosus* there is a conspicuous broad band of rather dense punctures on apical part of first tergite.

Sphecodes fasciatus v. Hagens

Siberia: Smolenschina, one female, Aug. 21 (Cockerell).

Mandibles red, black at base; second antennal joint swollen, about as long as fourth, and third not much shorter. The first two tergites red, the second with a transverse black band, failing in middle, and not reaching sides; the second tergite has near base on each side a black spot, which is densely minutely punctured; first tergite impunctate, second with sparse punctures on basal part. Hind wing with five hooks.

Blüthgen has recorded *S. fasciatus* from Irkutsk. My insect differs little from European *S. fasciatus*, and I will not venture to separate it, but if it is distinct, it is probably the female of *S. impunctatus* Meyor, described from the male and regarded as a race of *S. fasciatus*. A male I collected at Kychtak, Siberia, was sent to Blüthgen, and he supposed it might be *S. impunctatus*. This small species and its relatives belong to the subgenus *Sphecodium* Robertson, 1903.

Hylaeus cardioscapus Cockerell

Siberia: females from Smolenschina, Aug. 21 (Cockerell) and Archan, August (Cockerell). The latter is rather more melanic.

Hylaeus sibiricus (Strand)

Siberia: A female from Smolenschina, Aug. 17 (W. P. Cockerell) runs in my 1924 table to *H. wilmattae* Cockerell, but is very easily distinguished by the interrupted yellow band on collar, shining mesothorax, clear wings, and other characters. It is evidently the female of *H. sibiricus*, of which I have a male from the same locality. The long-cuneiform lateral face-marks are very pale yellow, the clypeus has a transverse red apical mark, the tubercles are light, and the tegulae have a light spot. In Hedicke's table of Central European species (1930) it appears to run nearest to *H. pectoralis* Förster, but compared with a specimen of that species it is entirely different.

Hylaeus atromicans Cockerell (variety?)

Siberia: females from Smolenschina, Aug. 17 (Cockerell) and the University Station on Lake Baikal, August (Cockerell).

H. atromicans was based on a single female from the east coast of Siberia. The holotype is now in the U. S. National Museum. The present specimens seem to agree well enough; they are readily distinguished from *H. rinki* (Gorski) by the plicate area of metathorax. On this character they would rather fall with *H. pfankuchi* (Alfken), which is smaller. The new specimens differ from the type of *H. atromicans* in being about as large as *H. rinki*. *H. pfankuchi* was described from Germany (1918).

Hylaeus annularis Kirby (variety?)

Siberia: Smolenschina, Aug. 21 (Cockerell). One female, differing from European specimens before me by having the collar entirely black, though the tubercles are light-spotted. There is a small cuneiform yellowish-white mark on each side of upper part of clypeus; the flagellum is clear red beneath except at base.

Hylaeus communis excurrens, new subspecies

FEMALE.—Length about 6 mm., anterior wing 5 mm.; black, almost without hair, the margin of the first tergite laterally has some very short, hardly noticeable hair. Head subelongate, not circular seen from in front; face marks confined to sides, orange, long-cuneiform, very slender below, above obliquely truncate, but at uppermost end rounded, so that the highest point is not on orbit; malar space very short; clypeus and supraclypeal area dull; facial foveae running parallel with orbit, and very close to it; antennae black, third joint about as long as fifth, fourth conspicuously shorter. Collar above with two very small yellow marks; tubercles yellow, tegulae with a large yellow spot; mesothorax dull, with dense but very evident punctures; scutellum somewhat shining, and the punctures larger; base of metathorax

with a broad transverse very strongly plicate glistening band, sharply separated from apical part of area, which is dull and granular; mesopleura finely punctured, like mesothorax. Wings dilute reddish brown, stigma dark reddish; first recurrent nervure meeting intercubitus. Legs black, with a yellow spot at base of front tibiae, and hind tibiae with about the basal third pale yellow. Abdomen highly polished, first tergite appearing impunctate under a lens, second very finely punctured; the microscope shows widely scattered excessively minute piliferous punctures on first tergite.

Siberia: Smolenschina, near Irkutsk, Aug. 17 (Cockerell).

Very like *H. communis* Nylander, but differs by the shape of the lateral face-marks, and the light marks on collar. It is not the variety *ebeninus* Foerster, the female of which has the front and middle tibiae yellow at base, and the hind tibiae with basal half yellow. The variety *nigri-facies* Alfken is based on a black-faced female. I suppose that the present insect represents a valid race, but the discovery of the male may show it to be a distinct species. The metathorax is suggestive of *H. gracilicornis* Morawitz, but that is a smaller species, with the flagellum reddened beneath.

The above species of *Hylaeus* may be separated (females) thus:

- 1.—Face all black; wings reddened; tubercles yellow. *atromicans* Cockerell.
Face with light marks; tubercles at least partly light. 2.
- 2.—Face-marks short, cuneiform, white, next to upper part of clypeus, and away from orbits. *annularis* Kirby.
Face-marks elongate. 3.
- 3.—Face-marks broad above. 4.
Face-marks narrow. *cardioscapus* Cockerell.
- 4.—Face-marks orange, clypeus all black. *communis excurrentis* Cockerell.
Face-marks light yellow, clypeus with a red apical mark. *sibiricus* Strand.

In general, the Asiatic *Hylaeus*-fauna seems to be very distinct from that of Europe. Alfken (1936) has recently published a list of thirteen species from Tadzhikistan and Turkmenia, and only one of these (*H. variegatus* Fabricius) is in Hedicke's table of central European species. Another (*H. punctus* Foerster) was described from Dalmatia.

C. P. Alexander (1935) has published a list of the species of *Tipula* of Palearctic Central Asia, and it is remarkable that the species are nearly all peculiar to Asia. Even the common *Tipula oleracea* Linnaeus appears to be absent from Central Asia.

AMERICAN MUSEUM NOVITATES

Number 950

Published by
THE AMERICAN MUSEUM OF NATURAL HISTORY
New York City

Sept. 28, 1937

BEES OF THE GENERA *HALICTUS* AND *CERATINA* FROM SIAM

By T. D. A. COCKERELL

The bees recorded below, which will be found in The American Museum of Natural History, were collected a little more than ten years ago, but were set aside owing to the pressure of other matters. The Halictines may be separated by means of the following table:

- 1.—Green species, with black abdomen.....*speculibasis*, new species.
Black species.....2.
- 2.—Male; flagellum long and black; basitarsi pale yellow...*metenus*, new species.
Females.....3.
- 3.—With distinct apical hair-bands on tergites.....*fimbriatellus* Vachal.
Without such bands.....4.
- 4.—With evident basal hair-bands on tergites; tergites with dark margins; postscutellum covered with dense tomentum.....5
Without such bands.....9.
- 5.—Larger species; disc of mesothorax highly polished.....*albescens* Smith.
Smaller; mesothorax duller, or quite dull.....6.
- 6.—Head longer than broad.....7.
Head not longer than broad.....8.
- 7.—Supraclypeal area highly polished.....*callorhinus*, new species.
Supraclypeal area not polished.....*nasicensis* Cockerell.
- 8.—Mesothorax dull; tegulae clear red.....*semivagans*, new species.
Mesothorax shining on disc.....*cattulus* Vachal = *vagans* Smith (sens. lat.).
- 9.—Larger species, wing over 6 mm.; mesothorax very highly polished and almost impunctate; postscutellum not covered by tomentum.
sutepinus, new species.
Otherwise.....10.
- 10.—Mesothorax dull (partly shining in *H. bambusarum*).....11.
Mesothorax shining; stigma reddish; postscutellum not covered with dense tomentum.....13.
- 11.—With some obscure metallic tints, conspicuous on posterior truncation of thorax; postscutellum densely tomentose; area of metathorax shining.
bambusarum, new species.
With no metallic tints.....12.
- 12.—Stigma dark brown; area of metathorax entirely dull.
latitarsis semiotopacus, new subspecies.
Stigma dilute reddish; head very broad (*Pachyhalictus*).
puangensis, new species.

13.—Area of metathorax brilliantly shining posteriorly; hind basitarsi dark.

sutepellus, new species.

Area of metathorax not shining posteriorly; hind basitarsi red.

perihirtulus, new species.

***Halictus (Pachyhalictus) puangensis*, new species**

FEMALE.—Length about 6.3 mm., anterior wing 5 mm.; black, very robust, the abdomen nearly 2.5 mm. across. Head very broad, as in *H. burmannus* Blüthgen, not evidently narrowed below, the vertex not elevated, the posterior ocelli, seen from in front, being on the line of the vertex (not below it, as in *H. intricatus* Vachal); mandibles reddish apically; flagellum red beneath, and the apical part somewhat reddened above; clypeus dull, with a pair of low bosses on lower margin, about as far apart as either from side of clypeus; supraclypeal area entirely dull; front dull, with very fine sculpture; vertex shining at each side of ocelli. Hair of head and thorax dull whitish, very scanty on head, very thin on mesothorax, dense and creamy white on postscutellum, dense on tubercles above and adjacent part of collar; margin leading to tubercles sharp and salient; mesothorax dull, entirely covered with a coarse raised network; scutellum dull and rough; area of metathorax very large, entirely dull, with very strong irregular plicae; posterior truncation dull, very broad, sharply bounded at sides and above; tegulae rather pale reddish. Wings dusky hyaline (compare *H. murbanus* Blüthgen), stigma dusky reddish brown, nervures pale, first recurrent reaching apical corner of the rather narrow second cubital cell. Legs black, with pale hair, small joints of front and middle tarsi reddish, hind tarsi entirely rather dark red. Abdomen with first tergite polished and shining; the other tergites dullish, the second and third with a very fine pruinose pubescence, giving a bluish appearance, a pale hair-band (only visible at sides) at base of second, and margins of second and third with the hair a little denser, giving the effect of faint bands; fourth tergite with a band of pale hair on each side, and the actual margin brilliantly shining; caudal rims and apical margin with dense, slightly yellowish, hair. Microscopic characters: apical part of first tergite with excessively weak, hardly visible sculpture, and bare, abruptly contrasting with the second, which is covered with appressed hairs; hind spur with about three small dark teeth on basal half, the apical half slender and simple; front finely lineolate and irregularly subreticulate, the sculpture weak, not at all like that of mesothorax; scutellum coarsely reticulate, like mesothorax; base of metathorax with large quadrate areas surrounded by raised margins, forming an excessively coarse network.

Siam: Kum Puang Creek, Jan. 26, 1928 (Cockerell).

In Blüthgen's table (1926) this appears to run best to *H. reticulosus* Dalla Torre, from which it is easily known by the character of the pubescence, with the pruinose second and third tergites of abdomen. There is some resemblance to *H. murbanus* Blüthgen, 1931, from Singapore and Sumatra, which has a similar head, but the pubescence and sculpture are different.

***Halictus albescens* Smith**

Siam: Nan, Jan. 14 (Cockerell), one female.

This is *H. albescens*, as restricted in my table made from the types at

British Museum (Ann. Mag. Nat. Hist., July, 1930, p. 56). It is not *H. senescens* Smith or *H. lahorensis* Cameron.

***Halictus (Indohalictus) latitarsis semiopacus*, new subspecies**

FEMALE.—Length about 5.5 mm., anterior wing 4.3 mm.; black, including mandibles, the flagellum very faintly brownish beneath; the scutellum, postscutellum and hind part of mesonotum appearing slightly greenish in contrast with the large, entirely dull, intensely black area of metathorax. Hair of head and thorax whitish, very scanty, but dense on tubercles, and a strong fringe along each side of metathorax. Abdomen shining black, without hair-bands; under side of abdomen with long yellowish hair. Wings hyaline, stigma very large, dark brown; second and third cubital cells very narrow, about equally wide; tegulae clear red. Very close to *H. mcgregori* Cockerell (Philippine Is.), and best regarded as a subspecies, but conspicuously smaller and less robust, with clearer wings, the smaller head with the face strongly shining on each side near the antennae. Typical *H. mcgregori* is 7 mm. long.

Siam: Mekami River, Feb. 2, 1928 (Cockerell).

Blüthgen (1926) considers *H. mcgregori* a synonym of *H. latitarsis* Friese, 1909, described from New Guinea. Blüthgen states that he has seen it also from Sumatra and the Philippine Islands. He states that the female is 6 to 6.5 mm. long. Friese's description does not seem to contradict the reference, and we may consider that there is one very widely distributed species involved. It is a member of Blüthgen's subgenus *Indohalictus*, most of the species of which have metallic colors.

***Halictus sutepinus*, new species**

FEMALE.—Length about 7.3 mm., anterior wing 6.3 mm.; black, with the mesothorax, scutellum and abdomen highly polished, the pubescence whitish, very scanty. Head somewhat longer than broad, the face conspicuously narrower than in any of the fifteen species figured on Pl. v of Blüthgen's 1926 paper (Zool. Jahrb., Vol. LI); mandibles black; flagellum very obscurely brownish beneath; clypeus shining, with widely separated large punctures, and an indistinct median ridge; supraclypeal area convex, shining; front dull, except a shining band along orbits, and extending broadly to ocelli above; no hair covering sides of face. Mesothorax brilliantly shining, almost without sculpture, a strong median groove on anterior half; scutellum smooth and polished, gibbous, with a median depression; postscutellum dull, not covered with dense tomentum, the surface showing; area of metathorax large, with strong regular plicae, and a thick posterior margin; posterior truncation dullish, not sharply margined at upper part of sides; mesopleura highly polished, with very weak sculpture; tegulae very dark, almost black. Wings dusky hyaline, iridescent; stigma and nervures dark brown, outer nervures not much weakened, but lower side of third cubital cell very weak; lower apical corner of second cubital cell acutely pointed; first recurrent nervure meeting intercubitus. Legs black; hind femora with a large curled floccus; hind tibiae with long curled hairs beneath, these plumose, with exceedingly long branches; on outer side the hind tibiae have short black spines. Abdomen long-oval, smooth and highly polished, except

that the second and third tergites have a broad dull band at base; no hair-bands, but sides of abdomen with glittering white hairs, and apex with dark hair; venter with long thin white hair. Microscopical characters: hind spur with five rather short oblique teeth; scutellum smooth and polished, the disc impunctate, but with a median groove, and some strong punctures along hind margin; postscutellum with the surface finely wrinkled, with fine irregular plicae; area of metathorax large, not sharply banded in middle behind, its surface with about 22 long plicae, which are rather irregular, with some little side branches, the surface beyond the plicae shining; upper part of front finely and closely punctured, the punctures running more or less in rows.

Siam: Doi Suteh Mountain, Feb. 9, 1928 (Alice Mackie).

I have not found any very close relative of this striking species. It resembles such species as *H. albipes* Fabricius, and differs from most of the Siamese forms, in having the surface of postscutellum exposed, not covered with dense tomentum. In Bingham's table (Fauna Brit. India) it goes to *H. gutturosus* Vachal, which is the male of *H. fimbriatellus* Vachal, and is not at all allied. In my table of Philippinc Islands species (Phil. Jour. Sci., XV, 1919) it runs out at 16, on account of the dark tegulae. It does not agree with any of Blüthgen's species; it seemed to run near to *H. tenasserimicus* Blüthgen, but the shape of the head differs, and the antennae are quite differently colored.

Halictus metenus, new species

MALE.—Length about 6 mm., anterior wing 4.7 mm.; black, with an apical band on clypeus (not having any upward projection), the labrum (except margin) and an elongated mark on each mandible cream color. Head approximately circular seen from in front; orbits strongly converging below; face, front and cheeks with abundant grayish-white hair; clypeus dullish; upper part of front bare and very black, entirely dull; vertex shining, not elevated; scape all black; flagellum very long, obscurely brownish beneath. Mesothorax dullish, but shining on disc, with quite dense distinct punctures; scutellum strongly shining on disc; postscutellum densely covered with long grayish hair; area of metathorax poorly defined, broadly polished at sides and posteriorly, but the basal part with strong plicae; posterior truncation small, moderately shining, sharply defined at sides; middle of mesopleura strongly shining; tegulae amber color. Wings long, grayish-hyaline, stigma dark brown; nervures pale brown, outer nervures not weakened; second cubital cell broad, receiving recurrent nervure before end. Knees and basitarsi light yellow; anterior tibiae in front, the others at extreme apex, and small joints of tarsi, pale reddish. Abdomen highly polished, first tergite not evidently punctured under a lens; second and third tergites with narrow obscure grayish basal bands, weak in the middle. Microscopic characters: third antennal joint very short, not quite so long as second; punctures of mesonotum largely running in rows; posteriorly, the mesonotum has strong close punctures, and a little band of hair along hind margin; the scutellum is in complete contrast, with extremely small punctures, and these lacking or nearly so on disc; the area of metathorax has about ten well separated plicae; first tergite polished, with excessively minute scattered punctures, but second completely contrasting, rugosopunctate all over, though with a lens the difference is hardly noticeable.

Siam: Nan, Dec. 31, 1927 (Cockerell).

This cannot possibly be the male of any species recorded from the female in this paper. In Bingham's table it runs to *semiaerinus* Vachal (*splendidulus* Vachal), but it really resembles *H. philippinensis* Ashmead (*vagans* Smith), differing by the much longer antennae, darker stigma and different area of metathorax. In a table by Blüthgen it runs to *H. massuriensis* Blüthgen, which is much larger. It is not like any of the males described by Blüthgen in 1928; thus as compared with *H. vulcanius* Blüthgen, the vertex is not so elevated, the face is not so broad below and the clypeus is less produced. The orbits converge below much more than in *H. perakensis* Blüthgen. In the European fauna it falls nearest to the larger *H. laevigatus* Kirby, according to the tables, but it is really entirely different. The specific name is derived from a Malay word meaning black.

I saw *H. perakensis* and *H. vulcanius* in the Museum at Kuala Lumpur, and noted:

H. perakensis.—Small, very shiny black male, head oblong, face narrow; clypeus shining and all black, produced, apical corners projecting; area of metathorax long, dull, minutely roughened; wing with very large dark brown stigma; legs dark; abdomen brownish toward base.

H. vulcanius.—Small, slender, very shining male, its clypeus transverse, all black; supraclypeal area polished, prominent; scutellum highly polished; area of metathorax dull, little sculptured; legs dark brown; abdomen brown.

In some ways more related to *H. metenus*, but very much larger, is *H. polygamus* Blüthgen, which I saw at the same Museum, and of which I noted (male):

H. polygamus.—Larger than *H. impudicus* Blüthgen; apex of clypeus broadly yellow; antennae very long, dark, faintly reddish; prothorax angulate on each side above, and above angle white tomentum; mesothorax and scutellum all dull; hind basitarsi and base of tibiae yellow.

Halictus fimbriatellus Vachal

Siam: Nan, females, Dec. 28, 1927, flying about *Mimosa pudica* (Cockerell); Jan. 3, 1928 (Cockerell); Jan. 4 (Alice Mackie).

Halictus (Evyllaeus) semivagans, new species

FEMALE.—Length about 6.5 mm., anterior wing 5 mm.; black, including mandibles, antennae (flagellum obscurely reddish apically) and legs (tarsi reddened at ends). Hair of head and thorax thin, with a hardly perceptible fulvescent tint dorsally; head broad, but clypeus prominent; clypeus and supraclypeal area dull, but sides of face shining; front entirely dull, vertex shining; cheeks with conspicuous white hair. Mesothorax dull, with dense very fine punctures; scutellum shining, with a median depression: postscutellum densely covered with fulvescent tomentum;

area of metathorax rather short, shining, with fine close parallel plicae which reach the hind margin (style of *H. perhumilis* Cockerell); posterior truncation shining, sharply defined all round, its upper corners angular; mesopleura dull; tegulae amber color. Wings hyaline, stigma pale reddish testaceous, nervures pale, the outer nervures faint as in *Evylaeus*; second cubital cell broad, receiving recurrent nervure a fair distance from end. Abdomen with first tergite polished, the others duller; tergites 2 to 4 with basal bands of gray tomentum, very conspicuous, but visible only at sides of second when abdomen is contracted; apex with pale hair. Microscopic characters: apical part of first tergite with very fine punctures and extremely minute transverse striae; hind spur with three long shining spines.

Siam: Type from Ban Maa Hia, Feb. 11, 1928 (W. P. Cockerell). Also from Pahtoop Mountain, Jan. 11, at flowers of *Convolvulus* (Cockerell).

This is close to *H. vagans* Smith, but not the same. By the color of the tegulae it should be the allied *H. cuniculus* Vachal, but it cannot at all be reconciled with Vachal's description. In Blüthgen's table it runs to *H. pheidolopsis* Blüthgen as to sculpture, but abdomen is quite different; on abdominal bands to *H. burmensis* Blüthgen, but is otherwise different. It differs from *H. nasicensis* Cockerell in having the clypeus not shiny, and the area of metathorax different, of the type of *H. perhumilis* Cockerell. Blüthgen regards both *H. nasicensis* and *H. perhumilis* as forms of *H. vagans*, but I am not persuaded that this is correct.

Pahtoop Mountain, where we found *H. semivagans*, is a rounded limestone hill rising abruptly from the surrounding forested country, not far from Nan. It is rich in molluscs, and we collected there (determined by Tomlin) *Macrochlamys hainesi* V. Mts., *Megaustenia siamensis* (Haines), with varieties *albescens* Cockerell and *virescens* Cockerell, *Haploptychirus petiti* Gould, *Cyclophorus aquilus* Sowerby, *Prosopoeas anceyi* Pilsbry, *Limnaea spadicea* Morlet, and *Indoplanorbis exustus* (Deshayes). We found a cave, in which were numerous Orthoptera of the genus *Tachycines*, a fly (*Sphaerophoria indiana* Bigot), and an interesting beetle, *Hylophilus kempfi* Blair. The last was found by Miss Mackie, Jan. 10, in darkness. The other locality for *Halictus semivagans*, Ban Maa Hia, is near Chiangmai.

Halictus (Evylaeus) sutepellus, new species

FEMALE.—Length about 5 mm., anterior wing 4.3 mm.; black, rather slender, with very scanty pubescence, not forming spots or bands on abdomen. Head approximately circular seen from in front; mandibles black, flagellum dull red beneath; clypeus and supraclypeal area shining; lower sides of face, and also vertex, shining, but front dull, densely punctured. Mesothorax highly polished, with a median groove anteriorly, the microscope shows sparse minute punctures; scutellum shining; postscutellum minutely sculptured, not covered by tomentum; area of metathorax

hardly defined, the basal half with very fine irregular, partly anastomosing, rugae, this followed by a dull, transversely rugulose zone, and then by a broad polished one; mesopleura shining on disc, well punctured; posterior truncation of thorax well defined laterally; tegulae dark in front, red posteriorly. Wings dusky hyaline, stigma dark reddish; nervures very pale, appearing brown under microscope, the first recurrent joining extreme apical corner of second cubital cell. Small joints of tarsi rufescent; hind spur with three dark brown oblique spines. Abdomen polished, the first tergite impunctate, but less than basal half of second with fine punctures, this basal area, under a lens, appearing dull and black, contrasting with the shining, almost brassy, surfaces in front of and behind it.

Siam: Doi Sutep Mountain, Feb. 8, 1928 (Alice Mackie).

This rather closely resembles *H. lionotulus* Cockerell and *H. scintillans* Cockerell, from the Philippine Islands, but is separated by the non-tomentose postscutellum and the characters of the abdomen. *H. gedensis* Cockerell, from Java, is also allied.

Halictus (Evylaeus) perihirtulus, new species

FEMALE.—Length about 5.5 mm., anterior wing 4.3 mm.; black, including mandibles, antennae (the flagellum obscurely brown beneath), and legs, except that the hind tarsi are clear red, and the other tarsi reddish, but much more dusky; pubescence scanty, grayish white. Head seen from in front approximately circular; clypeus polished, with the lower marginal area roughened, and a sort of transverse ridge across the middle, only visible when looked at rather from above; sides of face shining, and even the front with a sort of sericeous lustre, the surface minutely and very densely punctured; vertex shining. Mesothorax small, finely and densely punctured, but shining; scutellum dullish, with a shining space on each side of disc; postscutellum minutely sculptured, the surface exposed, not covered with dense tomentum; area of metathorax very large, with very fine plicae or striae, the apical part not shining; under the microscope the area is hardly defined, covered with very delicate anastomosing rugae, the apical part with very fine curved transverse rugae on a minutely sculptured surface; posterior truncation well defined, feebly shining; mesopleura dull and rough; tegulae rufous. Wings hyaline, stigma red, nervures pale; second cubital cell broad, receiving recurrent nervure near end. Extreme base of front tibiae red; hind spur with two strong spines, on basal half. Abdomen broad, shining, hairy at sides and apex, but without hair-bands or spots; hind margins of tergites obscurely brownish; first tergite with extremely minute punctures, and transverse striae; second and third with the same type of sculpture.

Siam: type from Kum Puang Creek, Jan. 26 (Cockerell). One from Mckami River, Feb. 3 (Cockerell), has the flagellum clear red beneath, and the tegulae amber color, but it seems to be only a variety. One from Nan, Jan. 13 (Cockerell), is small, with amber-colored tegulae, and mandibles red in middle. It is possible, but not probable, that these other specimens represent different species.

This species is known from most of the small Siamese forms by the lack of conspicuous tomentum on postscutellum. I had at first confused

it with *H. sutepellus*, from which it is easily known by the dull apical part of metathoracic area. It seems near to *H. canillosus* (Vachal), which was fully described by Blüthgen, but it differs at once in the hind spur and the pubescence of thorax. In my table of Philippine Is. species it runs to *H. mcgregori* Cockerell (*latitarsis* Friese, according to Blüthgen), but that is larger, with much darker stigma, and other distinguishing characters. Also, by the moderately shining mesonotum it should probably run better to *H. melanurops* Cockerell, which is much larger and quite different.

The specific name refers to the characteristic appearance of the abdomen, seen from above, with outstanding pale hair all around.

Halictus (Evyllaesus) *nasicensis* Cockerell (variety?)

Siam: Nan, female, Jan. 14 (Alice Mackie).

This is so close to *H. nasicensis*, from N. W. India, that I cannot venture to separate it. It is about 5.5 mm. long, anterior wing 3.8 mm. It differs from *H. philippinensis* Ashmead (specimen compared with type) by the conspicuously smaller and narrower head. They agree in having the supraclypeal area dull, whereas in the specimens from Nan ascribed to *H. vagans* Smith, the supraclypeal area is shining. The dull mesothorax, the sculpture of scutellum and the striatulate front are also characters to separate it from typical *H. philippinensis*. The microscopical characters are: front microscopically striate; mesothorax with numerous small but very distinct punctures on a minutely tessellate surface; scutellum with extremely minute punctures, much smaller than those of mesothorax; area of metathorax crescentic, well defined, covered with irregular partly anastomosing plicae; hind spur with three stout spines; first tergite with very distinct, rather close, fine punctures on apical portion, but the base has only excessively minute piliferous punctures.

Granting that this insect should be referred to *H. nasicensis*, and separated from *H. vagans* or *philippinensis*, it still remains a question whether, as Blüthgen held, *H. nasicensis*, along with *H. emergendus* Cameron, 1908, should be referred to *H. matheranensis* Cameron, 1907.

Several years ago I made a table of Indian *Halictus* with black head and thorax, from the specimens in the British Museum, as follows:

- 1.—Abdomen at least partly red.....2.
- Abdomen not at all red.....4.
- 2.—Abdomen highly polished; first three tergites chestnut red; no hair bands; nervures pale, outer recurrent and intercubitus very weak; second cubital cell broad (Simla).....*indicus* Cameron, type [= *himalayensis* Bingham].

- Abdomen less polished; first two tergites ferruginous, third, dark, contrasting. 3.
- 3.—Wings pale brownish; second tergite not blackened laterally; abdomen with basal bands of tomentum on tergites 2 to 4.
deesanus Cameron, type [= *serenus* Cameron].
 Wings clear; second tergite with a blackish patch on each side; second cubital cell much broader than in *H. deesanus* (Matheran).
- latisignatus* Cameron, type.
- 4.—Legs pale yellowish fulvous (female); anterior femora dark; nervures and stigma extremely pale; a small species of the subgenus *Seladonia* . . . *clarus* Nurse.
 At least all the femora dark. 5.
- 5.—Males. 6.
 Females. 7.
- 6.—Area of metathorax with very coarse rugae; sides of face with pure white hair (Himalayas) *carianus* Cameron, type [= *feai* Vachal].
 Smaller; area of metathorax dull and minutely roughened; all the tarsi pale reddish yellow. *constrictus* Smith, type [syn., *paris* Bingham].
- 7.—Area of metathorax with very coarse vermiform rugae; wings reddish; mesothorax very distinctly punctured; abdomen very broad, tergites 2 to 4 with white basal hair bands (Salween Valley, Tenasserim) . . . *dasygaster* Vachal.
 Area of metathorax not thus sculptured. 8.
- 8.—Stigma rufouscous, dark; clypeus and supraclypeal area highly polished; hind margins of tergites hyaline. *nireus* Bingham [= *saluator* Cameron].
 Stigma pale reddish or yellowish. 9.
- 9.—Smaller; tegulae clear rufotestaceous; postscutellum densely covered with pale ochreous-tinted tomentum (Matheran) . . . *matheranensis* Cameron, type.¹
 Larger; tegulae darker. group of *H. albescens* Smith.

Without further reference to the specimens, it is impossible to say how many species or races are included in the series which Blüthgen refers to *H. vagans* Smith. Indeed, we cannot expect to reach certainty until good series, including both sexes, have been collected in the different localities. The synonymy quoted in the above table is due to Blüthgen.

Halictus (Evylaeus) callorhinus, new species

FEMALE.—Length about 5.3 mm., anterior wing 4.7 mm.; black, with thin grayish hair, the second and third tergites with rather narrow basal bands of grayish tomentum; mandibles black; flagellum with a hardly perceptible brownish tint beneath; tegulae dark brown, paler posteriorly. Wings rather dusky hyaline, stigma brown, nervures pale. Head suboval, but fairly broad; clypeus moderately shining, with a series of elongated grooves on lower part; supraclypeal area convex, highly polished, contrasting with all the surrounding parts; front moderately shining, with exceedingly delicate reticulate sculpture (as seen under microscope); vertex with a very broad polished area on each side of ocelli. Mesothorax shining, but punctured; scutellum brilliantly polished; postscutellum densely covered with tomentum;

¹ I further noted of *H. emergendus* Cameron, type, from the same locality: stigma pale fulvous; tegulae light rufotestaceous; area of metathorax shining, with raised lines. A little larger than *H. matheranensis*, but the same species.

area of metathorax large, hardly defined, shining, with strong plicae on basal half (compare *H. semisculptus* Cockerell); posterior truncation narrow, shining at upper end, sharply defined all around, the upper corners evenly rounded; mesopleura dull and rough, somewhat shining on disc. Second cubital cell broad, receiving recurrent nervure before end. Legs somewhat brownish, the tarsi reddish at end; hind spur very pale, with two very large spines, which are broadened apically (subspatulate), and a long keel-like lamella. Abdomen broad, first tergite highly polished, practically impunctate, except for a band of fine punctures in the subapical region; second tergite polished on basal third, duller and more sculptured beyond.

Siam: Nan, Dec. 31, 1927 (Cockerell).

A species of the *H. vagans* group, but amply distinguished by the shape of the head, the sculpture of the front and the peculiar hind spur. In my table of Philippine Islands species, it runs exactly to *H. philippinensis*, from which it is easily known by the polished supraclypeal area and other characters. Also, the stigma is more obtuse at end.

***Halictus (Evylaeus) bambusarum*, new species**

FEMALE.—Length about 6 mm., anterior wing about 5 mm.; black, robust, the dull posterior truncation of metathorax distinctly green; pubescence grayish, the postscutellum covered with dense tomentum, the abdomen with some very long hairs at sides of third and following tergites, and triangular patches of light tomentum at lateral bases of second and third tergites; mandibles black, faintly reddish apically; flagellum obscurely brown beneath; tegulae translucent rufotestaceous; wings hyaline, a little grayish; stigma reddish brown; nervures pale. Head broader than long; clypeus dull, depressed in middle, the apical part minutely striate; supraclypeal area flattened, large, dull, the microscope showing punctures and extremely minute longitudinal striae; at each side of supraclypeal area is a little polished space; front dull, in middle appearing very black, the microscope shows here a very dense striate-punctate sculpture, but at sides a very minute reticulation; vertex polished. Mesothorax dull in front, shining posteriorly, with a faint suggestion of greenish; in front the microscope shows very weak piliferous punctures on a minutely tessellate surface, posteriorly the punctures can be seen with a lens; scutellum highly polished; area of metathorax large, shining, with very distinct irregular radiating plicae, some with lateral branches; posterior truncation with its upper corners obtusely angular; mesopleura dull and rough in front, shining posteriorly. Second cubital cell broad, receiving recurrent nervure a considerable distance from end. Legs black, with pale hair, tinged with yellow on inner side of tarsi; hind spur reddish brown, with three very long spines. Abdomen broad, first tergite highly polished, second a little duller on apical half, the others dullish; the first tergite has extremely minute scattered punctures, as seen under microscope.

Siam: near Weing Sa, Dec. 25, 1927, on bamboo foliage (Cockerell).

Resembles in a general way *H. itaminus* Cockerell, from the Philippine Islands, but that is larger, with quite different area of metathorax, and dark tegulae. The smaller size and dullish posterior truncation of metathorax distinguish it from *H. postlucens* Cockerell. I have compared it with *H. gedensis* Cockerell, from Java, and it is quite distinct.

Halictus vagans Smith

Siam: Nan, Dec. 31, Jan. 8, Jan. 24, females (Cockerell).

These specimens agree with *Halictus philippinensis* Ashmead, 1905, which Blüthgen in 1926 declared to be a synonym of *H. cattulus* Vachal, 1894 (*catullus* by error in Bingham, Fauna Brit. India). In 1928, Blüthgen placed *H. cattulus* as a synonym of *H. vagans* Smith, 1858, described from Borneo, having been collected by Wallace in Sarawak. Smith called it *H. vagans* because it looked very like the European *H. leucozonius*, and so seemed like a wanderer from northern regions. *H. philippinensis* is so much smaller than *H. leucozonius* that the comparison does not seem apt. I do not feel sure that the lengthy synonymy proposed by Blüthgen is really justified, but not having compared the types I am not in a position to correct him.

Halictus (Chloralictus) speculibasis, new species

FEMALE.—Length 5.5 mm., anterior wing 4.5 mm.; head dark green, with the clypeus black; thorax black, with the mesothorax and scutellum blue-green; abdomen black, the tergites beyond the first with very broad brownish margins; tegulae translucent reddish-testaceous; wings grayish hyaline, stigma pale dull testaceous, nervures very pale; legs dark brown, the tarsi pallid apically. Head broader than long; apical half of mandibles red; flagellum obscurely reddish beneath; clypeus shining, well punctured, flattened in middle, with a little tubercle at each apical corner; supraclypeal area not polished; front mainly dull, but a shining space (much more shining than clypeus) on each side next to antennae; vertex polished and shining; hair of head and thorax dull white, thin. Mesothorax with an impressed line, shining on disc, finely punctured; scutellum highly polished on disc; postscutellum large, entirely dull black; area of metathorax poorly defined, finely plicatulate at base, swollen and shining behind; posterior truncation shining, sharply defined all round. First recurrent nervure ending not far from end of first cubital cell; outer recurrent and intercubitus much weakened. Legs with abundant whitish hair, a red brush at end of hind basitarsi. Abdomen broad, first tergite highly polished, appearing impunctate under a lens, second tergite shining and perhaps slightly greenish at base, dull beyond, and the following tergites also dullish; bases of tergites hoary with fine tomentum, on third especially forming an entire rather conspicuous band, and practically the same on fourth. Microscopical characters: front very minutely but sharply striate-reticulate; a slender keel between antennae; plicae of metathoracic area strongly wrinkled (much the style of *H. rystonotus* Vachal); tegulae not punctured; hind tibiae on inner side with long loose strongly plumose hairs; hind spur with three long spines; first tergite with excessively minute well separated punctures, tending to run in rows; punctures of second tergite similarly minute.

Siam: Nan, Dec. 30, 1927 (Cockerell).

Apparently near to *H. paradnanus* Strand, from Ceylon, but distinguished by the dark antennae and the sculpture of the mesothorax. The tegulae and other characters readily separate it from *H. serratus* Blüthgen. The wings at once distinguish it from *H. buccinus* Vachal.

Ceratina (*Ceratinidia*) *incertula*, new species

FEMALE.—Length about 6.7 mm., anterior wing 4.3 mm.; black, with chrome-yellow marks as follows: apical band on clypeus connected with a broad vertical band which is subtruncate at upper end, but not at all notched, the distance between the vertical band and the lateral marks considerably less than the width of the band, and also less than width of lateral marks at that point; long lateral face-marks, broadened below (with no inwardly directed point), narrow above, the upper end, well above level of antennae, curving away from orbit; long transverse supraelytral band; two large spots on front; mark on lower half of scape; broad band on cheeks, pointed at upper end; band on prothorax, nearly failing in middle, but laterally connected with the yellow tubercles; four slender lines on mesothorax, the lateral ones very short; scutellum (but not axillae); broad band on first tergite, very deeply incised on each side of middle by a large black spot; slender line on second tergite, connected with a large spot at each side; broadly interrupted band on third tergite, enlarged laterally; fourth tergite with a pair of claviform marks, separated only by a line in middle; fifth with a band which is very broad in middle, abruptly narrowed at sides, not reaching lateral margins. Sixth tergite, labrum, mandibles and flagellum all black; no yellow spot behind tubercles. Sides of mesonotum with the anterior half entirely dull and densely and minutely punctured, the posterior half mainly polished, but a broad dull densely punctured band runs across hind end of mesonotum; disc of mesonotum with distinct punctures, well separated on a shining ground; tegulae rufotestaceous. Wings dusky, stigma and nervures reddish brown; basal nervure meeting nervulus. Anterior coxae large, with a rounded tubercle at upper end; all the knees, front and middle tibiae on outer side, and stripe on basal half of hind tibiae, lemon yellow; anterior tibiae red in front; tarsi light red; hind tibiae with copious pale hair.

Siam: Nan, Jan. 13, 1928 (Alice Mackie).

In my table in *Ann. Mag. Nat. Hist.*, March, 1919, p. 246, this runs to *C. incerta* Cockerell, from which it is easily known by the yellow on middle and hind legs. It approaches *C. laosorum* Cockerell, 1929, also found at Nan, but that species has the vertical band of clypeus notched at upper end, scape all black and mesothorax without yellow lines. Another related species is *C. corbetti* Cockerell, 1929, from Kuala Lumpur, but this differs in the pattern of the legs and other characters. The stigma of *C. corbetti* is much darker.

AMERICAN MUSEUM NOVITATES

Number 951

Published by
THE AMERICAN MUSEUM OF NATURAL HISTORY
New York City

October 1, 1937

A NEW PRIMATE FROM THE UPPER EOCENE PONDAUNG FORMATION OF BURMA

BY EDWIN H. COLBERT

INTRODUCTION

While studying an exceptionally fine collection of Eocene mammals from Burma, made by Barnum Brown in 1923, I had the good fortune to discover the specimen that forms the subject of this paper. It was associated with some other fossils, all of which were very fragmentary, and because of its small size and its rather unpromising appearance it seemingly had been overlooked, or at least its importance had not been realized, when the collection was catalogued.

This specimen, consisting of a fragmentary mandibular ramus containing a few teeth, would seem to be a primate, and as such constitutes an important addition to our knowledge of the upper Eocene Pondaung fauna of Burma. At the present time an extensive paper on the fossil mammals of Burma has been completed, a study based on the collection gathered by Dr. Brown in the Pondaung and the Irrawaddy formations, and naturally a consideration of the specimen to be described in this present contribution will be included in the above mentioned monographic study. In view of the fact, however, that the longer paper will not be published for some time, it seems advisable to bring out this preliminary description in order that some information about the new primate herein described will be available.

I wish to express my deep appreciation to Dr. William King Gregory for the invaluable aid and the numerous helpful suggestions that he has given me during the preparation of this paper.

The illustrations accompanying this description were made by Louise Waller Germann.

Simiidae (?)

Amphipithecus mogaungensis, new genus and species

TYPE.—Amer. Mus. No. 32520, a left mandibular ramus with P_3-4 , M_1 .

PARATYPES.—None.

HORIZON.—Pondaung, Eocene.

LOCALITY.—One-half mile northwest of Mogaung, Burma.

DIAGNOSIS.—A relatively small primate. Mandible very deep and heavy in

comparison with the size of the cheek teeth, with a very short, vertical symphysis and a heavy lingual torus. There is a pronounced pit on the posterior surface of the symphysis for the genioglossus muscle. Mental foramen beneath the fourth premolar, and placed about midway between the alveolar and the ventral borders of the jaw.

Dental formula seemingly $2-1-3-2$. Premolars very much compressed antero-posteriorly and transversely broad, due to the lingual extension of the postero-internal corner of each tooth. Crowns of premolars almost as high anteriorly and posteriorly as in the region of the central cone. Crown patterns very peculiar, consisting essentially of a central cone, from which run ridges anteriorly, posteriorly and internally, this last ridge joining at the postero-internal corner of the tooth with a posterior transverse ridge, to enclose a postero-internal fossa.

Molars brachyodont, with trigonid and talonid of subequal heights, narrower anteriorly than posteriorly. Protoconid and metaconid rather close together, hypoconid and entoconid farther apart and forming a part of a continuous rim around the well-developed talonid basin. Paraconid seemingly present but very small, hypoconulid incipient.

Roots of cheek teeth very long and vertical. P_4 with four roots, of which the antero-internal one is small. P_3 with three roots, there being no antero-internal root. P_2 with two roots, one internal and one external, but so fused as to form a single transverse root.

Canine root vertical, flattened, the internal surface being very flat and the external surface being rather convex. No appreciable diastema between canine and second premolar.

The generic and specific diagnoses are the same.

To reiterate in a detailed manner the information set forth in the foregoing diagnosis, the following description is presented.

As to size (on the basis of tooth dimensions), this new form is slightly larger than the Fayûm genus, *Propliopithecus*, and the American form, *Pelycodus*, and is more or less comparable to the bunodont artiodactyl, *Wasatchia*. It is at once distinguished, however, by its very heavy mandibular ramus and its short symphyseal region. The relationship between the depth of the ramus and the length of the first molar may be expressed in the following terms:

Length of M_1 = 6.3 mm.

Depth of ramus = 19.5 mm.

Length of M_1 /depth of ramus = $6.3/19.5 = 31/100$.

In other words, the depth of the mandibular ramus is about three times as great as the length of the first lower molar. The mandibular symphysis is heavy and vertical, and its posterior border is opposite the second premolar. The ramus is thick, due to the well-developed lingual torus. The mental foramen is surprisingly high and in a posterior position, being beneath the fourth premolar.

Unfortunately the anterior portion of the mandible is broken away, so that no information is to be had about the incisor teeth. However, the vertical position of the canine root renders impossible a very marked alveolar prognathism of the incisors, and as this jaw is possibly that of a higher primate (as will be shown below) it probably had not more nor less than two incisors on each side. It would seem certain that there was a well-developed canine, three premolars (following the canine without any appreciable diastema) and probably three molars. The jaw is broken behind the first molar, so that the last two teeth are missing.

Of the canine, only a basal portion, deep in the mandibular ramus is preserved. This fragment serves to give some information as to the position and the cross section of the root of this tooth. Evidently the canine root was flattened, with a very flat inner surface and a convex outer surface, and its long axis was placed obliquely to the dental arcade. The position of the canine root and the preserved portion of the alveolus show that this tooth was vertical.

The premolars of this specimen are quite distinctive. They are characterized particularly by their rather high crowns and long roots, and by the peculiarity of their coronal surface patterns. Each premolar is very broad posteriorly and narrow anteriorly, and because of the short antero-posterior diameters of these teeth, this causes the postero-internal portion of each tooth to be extended lingually to a very considerable degree. Each tooth has a central cone, from which ridges extend anteriorly, posteriorly and internally. It is an interesting fact that the anterior and posterior ridges do not slope downward toward the base of the tooth to any appreciable degree, but instead they are almost as high as the central cusp. On the internal side of the tooth there is a very small anterior fossa or pocket, lying between the median transverse ridge and the anterior corner of the tooth, and a posterior fossa, lying between the median ridge and a posterior transverse ridge. These transverse ridges are not horizontal, but slope very strongly from the median to the lingual borders of the tooth, so that the fossae or pockets face obliquely upward and inward. The external or buccal side of each tooth is sculptured by a cingulum that runs in a semicircle from the base up to the anterior and posterior portions of the tooth, and by a central vertical ridge, extending up to the main cusp. All in all, the crowns of these teeth, though peculiar in their configuration and difficult to describe, are essentially similar to the bicuspid of some of the higher primates. The figure clearly shows their form.

The last premolar has four roots, two internal and two external. of



Fig 1 *Amphapithecus mogaungensis*, new species Type, Amer. Mus. No 32520, fragment of left mandibular ramus with roots of canine and P_2 and P_3-M_1 . Crown view above, external lateral view below Three times natural size

which the anterior internal one is very small. There are only three roots in the third premolar, for there is no antero-internal root. The second premolar, of which the crown is missing, would seem to have a single internal and a single external root, probably corresponding to the posterior roots of the fourth premolar, strongly fused to form one large transverse root. The roots of the cheek teeth are all extraordinarily long and vertical—a character typical of many of the higher primates



Fig. 2. *Amphipithecus mogaungensis*, new species. Type, Amer. Mus. No. 32520. Internal lateral view. Three times natural size.

The first molar is a somewhat elongated tooth, with a brachyodont crown and long roots. The trigonid is relatively low, so that it is not appreciably elevated above the talonid. The front portion of the tooth is somewhat narrower than the posterior portion, so that the protoconid and the metaconid lie closer to each other than do the hypoconid and the

entoconid. These cusps are essentially conical, but a low transverse ridge connects the anterior ones, while anterior and postero-transverse ridges from the posterior cusps form a rim around the basined talonid. In front of the metaconid is a flat facet, the center of which shows a small pit, evidently indicating the presence of a very small paraconid. There are well-developed cingula on the anterior portion of the tooth, both externally and internally, while at the back of the molar there is a very slight cingulum. At the external junction of this posterior cingulum with the talonid rim there is evidence of an incipient hypoconulid, but the indications of this cusp are so slight that it may be considered as non-existent. It would seem that we see here the initial stage in the formation of a hypoconulid.

DISCUSSION AND COMPARISONS

The relationships of this fragmentary specimen are difficult to determine with complete accuracy, but an extended study on a comparative basis would seem to indicate that its affinities certainly must lie within (a) the primates, (b) the condylarths (comparing it in this case with *Hyopsodus*), (c) the rodents, and (d) the artiodactyls. These are the only mammalian orders in which the molars are comparable to the molar of the specimen in question, and of these orders only in the primates are there to be found premolars comparable to its premolars.

Of these possibilities, the rodents and the condylarths may be pretty certainly eliminated. In the first place, the premolar pattern is quite unlike anything found in the rodents. Furthermore, the shape of the canine would preclude any rodent affinities for this specimen. Thus, about the only rodent resemblances are to be found in the general molar pattern (similar in a way to some of the Tertiary sciurids) and the depth of the mandibular ramus. But these are characters that can be duplicated in various other orders, to be considered below.

Considering now *Hyopsodus*, it may be noted that the greatest resemblance is to be found in the general pattern of the molar. Even here, however, the resemblances are due mainly to the common convergence of patterns, in which the presence of four or five main cusps, a basined talonid and a rather low trigonid are essential features. Yet in spite of certain resemblances there are very apparent differences in the first molar, such as the anterior oblique ridge from the hypoconid and the presence of a hypoconulid in *Hyopsodus*. Furthermore, when other characters of the specimen are compared with *Hyopsodus* the differences become even more pronounced. This is to be seen particularly in the pro-

found dissimilarity between the two forms in the premolars and in the depth of the mandibular ramus.

The form now under consideration shows certain resemblances to some of the primitive bunodont artiodactyls in the construction of the molar. Thus the first lower molar of *Amphipithecus* is very close indeed to the same tooth of *Wasatchia*, a dichobunid from the Eocene of North America, particularly because of the essentially similar character of the cusps, the low trigonid and basined talonid, and the anterior narrowing of the tooth. Yet even in these two very similar teeth certain differences are to be seen, especially in the beginnings of a crescent with medially extending arms (an artiodactyl character) on the hypoconid of *Wasatchia*. And when other details in the two forms are compared, such as the build of the premolars and the configuration of the mandibular ramus, the differences between them are seen to be pronounced. Therefore the specimen is to be ruled out of the Artiodactyla.

This leaves the primates to be considered, and here the resemblances would seem to be close in the form of the jaw and of the teeth. The depth of the mandibular ramus and the abbreviation of the symphyseal region are characters of especial significance, for they approximate closely the condition to be found in certain Tertiary and later primates.

A comparison of *Amphipithecus* with the lemurs, either fossil or recent, shows so many differences that the Burmese form may at once be excluded from this group of primitive primates. Thus, the lemurs are characterized by the shallow mandibular ramus, the long mandible with a relatively horizontal symphysis, the generally cross-crested or crescentic-crested molars and the comparatively simple and usually conical premolars. All of these characters are in decided contrast to those of the form under consideration.

Nevertheless, certain lemuroid features are to be seen in *Amphipithecus*. The premolars, for instance, might be considered as showing a somewhat intermediate stage between some of the primitive lemuroids, such as *Pelycodus*, and some of the primitive anthropoids. These teeth in the Burma form are much closer to those of the anthropoids than they are to those of the lemuroids, showing that the new genus is definitely of anthropoid relationships, while it retains some of its primitive lemuroid heritage characters. Then again, the first lower molar of *Amphipithecus*, by its form and the arrangement of its cusps, might have been derived from a lemuroid molar similar to that of *Pelycodus*, but again this tooth is advanced to a position closer to the anthropoids than to the lemuroids by reason of its low trigonid and the loss of its sectorial characters.

Similarly, *Amphipithecus* may be excluded from the tarsioid group. For the tarsioids are characterized by the shallow, elongated mandible, the more or less sectorial molars, the conical or simple premolars, and the shallow, inclined symphysis with forwardly inclined incisors and canines, all of which characters are in decided contrast to the comparable features of *Amphipithecus*.

The presence of three premolars in *Amphipithecus* at once suggests the possibility of a relationship with the South American Cebidae. Not only the dental formula but also the deep mandibular ramus and the abbreviated symphysis are characters by which it resembles after a fashion the New World monkeys.

In the New World monkeys the second premolar is a large, well-developed tooth, considerably larger than the two premolars that follow it. In *Amphipithecus*, on the other hand, the second premolar was seemingly very small—evidently it was a structure that was disappearing. Consequently it would seem that the presence of a second premolar in this Burmese form may be merely the retention of a lemuroid or tarsioid character in a primitive anthropoid form.

It might be pointed out that there is a certain resemblance between the premolar patterns in this Burmese primate and in *Alouatta*, a resemblance that is shown in a graphic way by the accompanying figure. Yet this resemblance is not close enough to indicate any true affinity. It may be rather a parallelism in the development of these teeth.

Then again, the deep ramus and the abbreviated symphysis of some of the South American monkeys, although affording a superficial resemblance to the same features of the Burma form, are when critically examined seen to be of a secondary and independent origin.

All in all, it would seem that the main resemblance of *Amphipithecus* to the South American monkeys is to be found in the presence of a second premolar. And since the second premolar of the Burmese form is small, the evidence would seem to point to the fact that it does not constitute a character linking this new genus with the South American forms (in which the second premolar is quite large) but rather that it is a retained primitive feature in a true Old World primate.

Since it would seem that *Amphipithecus* may be logically eliminated from the lemuroids, tarsioids and platyrrhine primates, the question of its affinities to the Old World primates, the catarrhines, may now be considered. In this connection some interesting comparisons may be made.

The obvious comparison is, of course, that between *Amphipithecus* and the supposed primate from the Pondaung beds, *Pondaungia*. This

latter genus, described by Pilgrim, is characterized by its very small size, its quincubercular upper molars and its seemingly quadritubercular lower molars. Unfortunately, no direct comparisons between *Pondaungia* and the new genus can be made, for the former consists of the first two upper molars and the last two lower molars, whereas only the first lower molar of *Amphipithecus* is known. But a comparison of a first lower molar against a second lower molar would seem to indicate that the two forms are quite unlike each other in their tooth characters. In *Amphipithecus* the molar is long, with a narrow trigonid and a broad, basined talonid; the metaconid is somewhat posterior to the protoconid and the entoconid is lingually placed as compared with the other cusps. In *Pondaungia*, on the other hand, the molar is more square in its outline, and the cusps would seem to be aligned transversely. Again, the mandibular ramus of *Pondaungia* is rather shallow, a decided contrast to the very deep ramus of *Amphipithecus*. Therefore, even though the points for a direct comparison between the two Burma specimens are few, the evidence would seem to be sufficiently strong to show that they are distinct, each from the other.

Some of the earliest catarrhines are known from the lower Oligocene beds of the Fayûm, Egypt. Three genera are of particular interest, namely, *Apidium*, considered by Gregory as a structural ancestor of the cercopithecoid monkeys, and *Parapithecus* and *Propliopithecus* (to be discussed below), forms seemingly ancestral to the higher anthropoids. In *Apidium* the last lower premolar is essentially conical, with only the beginnings of an internal cusp that might eventually lead to a bicuspid structure, while the lower molars are marked by the multiplicity of cusps, there being, beside the four main cusps, a hypoconulid and a small cusp at the anterior end of the crista obliqua. The mandibular ramus is comparatively shallow. All these points are in decided contrast to *Amphipithecus*.

Considering further the cercopithecoids, it is possible to make certain comparisons between *Amphipithecus* and some of the more advanced and geologically younger forms, such as *Mesopithecus*, a monkey from the Pikermi beds of Pliocene age. In *Mesopithecus* there is in the fourth premolar a high central external cusp with a cross-ridge running internally from it, and anterior and posterior basins. In the third premolar the main cusp stands up prominently, without any cross crest running inwardly from it. These teeth, by reason of the development of their anterior and posterior basins and the lingual projection of their postero-internal corners, resemble to some extent the premolars of *Amphipithe-*

cus. Yet there are so many differences in the premolars of these two forms that no close relationship between them is to be imagined. There should be noted especially the anterior and posterior height of the premolars in *Amphipithecus*, making the teeth flat across the top, rather

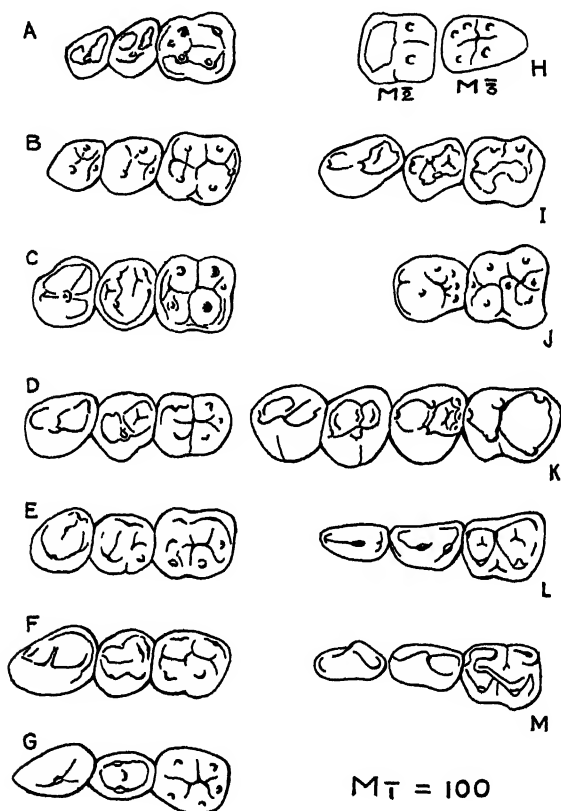


Fig. 3. Left P_3 -4, M_1 of various primates and an artiodactyl. (H, M_2 -3; K, P_3 -4, M_1 .)

SIMIIDAE:—A. *Amphipithecus*—Eocene, Burma; B. *Parapithecus*—Oligocene, Egypt; C. *Propithecus*—Oligocene, Egypt; D. *Dryopithecus*—Miocene, Europe; E. *Pan*—Recent, Africa; F. *Gorilla*—Recent, Africa; G. *Hylobates*—Recent, Orient; H. *Pondaungia* (this family?)—Eocene, Burma.

CERCOPITHECIDAE:—I. *Mesopithecus*—Pliocene, Greece; J. *Apidium*—Oligocene, Egypt.

CEBIDAE:—K. *Alouatta*—Recent, Central America.

LEMURIDAE:—L. *Pelycodus*—Eocene, North America.

ARTIODACTYLA:—M. *Wasatchia*—Eocene, North America.

than pointed, a condition quite different than what is found in any of the cercopithecoids.

In *Mesopithecus*, as in other cercopithecoid monkeys, the molars are highly specialized as bilophodont teeth, and therefore offer a great contrast to the bunodont molar of *Amphipithecus*.

Parapithecus and *Propliopithecus* are generally considered as being very primitive anthropoids, and as such are of particular interest in this comparative study. In *Parapithecus* the mandibular ramus is relatively more shallow than it is in *Amphipithecus*, the symphysis is relatively less massive, and it would seem probable that the mandibular rami diverge to a greater degree than was the case in the Burma form. In these respects it may be said that *Parapithecus* shows more primitive characters than does the new genus from Burma. On the other hand, the molars of *Parapithecus* resemble, to a certain extent, the molar of *Amphipithecus*. In the Fayûm genus these teeth are brachyodont, with talonids broader than the trigonids. It should be noted, however, that the difference in height between the trigonids and talonids is greater than in *Amphipithecus*, and that a hypoconulid is present. The premolars of *Parapithecus* are more primitive than those of *Amphipithecus*, and they consist essentially of simple cones with low, posterior heels.

In many respects *Propliopithecus* shows more resemblances to *Amphipithecus* than does *Parapithecus*. In *Propliopithecus* the mandibular rami are less divergent (as was probably the case with *Amphipithecus*) than they are in *Parapithecus*, the mandible is heavy and deep, and the symphysis is strong. The molars are perhaps more advanced toward the anthropoid habitus than are the molars of *Amphipithecus*, for they are rather square, instead of being elongated. There is a well-developed hypoconulid. The form of the premolars, also, resembles to a certain extent the configuration of the premolars of *Amphipithecus*. Thus the fourth premolar of *Propliopithecus* has a high central cusp with a transverse ridge running inwardly from it, anterior and posterior fossae, and a somewhat lingually produced postero-internal border.

It was shown on a foregoing page that the length of the lower first molar is to the depth of the mandibular ramus in the ratio of 31/100. This may be compared with the ratios of molar length to mandibular depth in various primates as listed below.

	Ratio—length of M ₁ /depth of ramus
<i>Amphipithecus</i>	31/100
<i>Mesopithecus</i>	32/100
<i>Propliopithecus</i>	37/100

Proconsul
Dryopithecus frickae

29/100
 38/100

Thus the relationship between the depth of the mandibular ramus and the cheek teeth is somewhat similar to what exists in certain anthropoid primates, and is quite apart from the shallow mandibular ramus found in the typical lemuroids and tarsioids.

An outstanding character of the jaw of *Amphipithecus* is the strong, well-developed lingual torus on the inner side of the ramus. In this respect the jaw of this specimen is most decidedly ape-like, since the presence of a heavy lingual torus is a typical feature of the higher anthropoids. The accompanying table shows the proportionate thickness of the mandibular ramus beneath the first molar to the breadth of the first molar in various genera of primates. From the ratios, it is at once apparent that *Amphipithecus* in this respect resembles most closely certain anthropoids, such as *Parapithecus*, *Propliopithecus*, *Dryopithecus* and *Gorilla*.

Ratio—width of M_1 to width of
 ramus below M_1

<i>Amphipithecus</i>	66
<i>Parapithecus</i>	67
<i>Propliopithecus</i>	61
<i>Pliopithecus</i>	77
<i>Mesopithecus</i>	82
<i>Dryopithecus</i>	58
<i>Gorilla</i>	65
<i>Hylobates</i>	98
<i>Ateles</i>	94
<i>Alouatta</i>	85

Another very characteristic feature of the mandible of *Amphipithecus* is the presence of a deep pit for the insertion of the genioglossus muscle on the posterior mid-portion of the symphysis. The presence of such a pit is a diagnostic character in the advanced primates, and can be seen particularly well developed in many of the platyrrhine and catarrhine genera.

The position of the mental foramen beneath the fourth premolar and rather high up on the surface of the ramus is a feature that would seem to be peculiar to the genus now under consideration. That is, this foramen is more posteriorly and more highly situated than it is in any of the other primates. Thus in the tarsioids, it is far forward, beneath the second and third premolars or beneath the second premolar and the canine, and it is located near the inferior border of the ramus. The same is true of the lemurs, where there are often two or three exits for the mental ca-

nal. In the platyrrhines this foramen is beneath the second and third premolars while in most of the catarrhines it is beneath the third premolar. It is an interesting fact, however, that in certain of the advanced anthropoids, particularly the gorilla and the orang, the mental foramen is beneath the fourth premolar, as it is in *Amphipithecus*, although it is lower on the mandible. Thus again the new genus from Burma would seem to show its closest affinities with certain of the higher anthropoids.

Again, the abbreviation of the symphysis and the crowding together of the canine and the premolars are characters that would seem to link this specimen definitely with the primates. Here too, the resemblances are with the more advanced primates belonging to the great anthropoid group rather than with the lemuroids and the tarsiods, in which the jaw is longer and the symphysis more extended. In this same category are the long, vertical roots of the cheek teeth in *Amphipithecus*, constituting still another resemblance to the higher primates, particularly to the more advanced members of the platyrrhine and catarrhine groups.

The position of the canine root, as it is preserved, deep in the mandible, affords a resemblance to some of the anthropoids, such as *Parapithecus*, *Propliopithecus* and *Dryopithecus*. The position of the canine alveolus immediately in front of the second premolar, and without the intervention of an appreciable diastema, indicates that the canine was a strong, upright tooth, similar to the canines of the above mentioned forms, and not a forwardly inclined tooth, such as is typical of the tarsiods. No definite conclusions can be drawn as to the form of the canine except that it was rather flattened.

It has been stated in a preceding paragraph of this paper that the premolars and the molar of *Amphipithecus* are, generally speaking, somewhat intermediate between the teeth of certain Eocene lemuroids, such as *Pelycodus*, and the primitive anthropoids, and it was also pointed out that these teeth of *Amphipithecus* are closer to the teeth of the higher primates than they are to those of the primitive lemuroids. That is, the premolars of *Amphipithecus* are, supposing a certain amount of change consequent upon evolutionary specializations, derivable from relatively simple premolars like those of *Pelycodus*, but by reason of their specialized crown patterns they are more closely comparable to the premolars of *Mesopithecus*, *Propliopithecus*, *Dryopithecus* and *Gorilla*. It might be said that the premolars of *Amphipithecus* are truly primitive anthropoid bicuspid. On the other hand, these same specializations of the crowns in the premolars of *Amphipithecus* cause them to be different from the premolars of any of the above-mentioned forms, when close comparisons are made.

The first lower molar of *Amphipithecus* is similar in certain ways to this tooth in *Pelycodus*, particularly with regard to the arrangement of the cusps and the relatively broad talonid. On the other hand, this tooth in the Burma genus is specialized in many ways in the direction of the higher primates, such as *Parapithecus*, *Dryopithecus* and the gibbon. Thus in both *Amphipithecus* and the gibbon the tooth is narrower anteriorly than it is posteriorly and in both the tooth is somewhat elongated. Moreover, their general crown patterns are not dissimilar. But a close comparison will show many differences, so that in the final analysis the molar, as was the case with the premolars, is developed along a line of specialization that sets it apart from the molars of any other primates. Generally speaking, it may be said that the molar of *Amphipithecus* is much more primitive than are the premolars. That is, the molar shows by reason of its pattern, the development of the trigonid and talonid, and by its proportions, that it is about as close to the more primitive, generalized Eocene primates as it is to the more advanced forms.

These features of the cheek teeth are brought out in the accompanying illustration.

<i>Amphipithecus</i>					e c.)	'hecus)
Characters in common with:						
Size	X			X		
Depth of mandible				X		
Lingual torus						X
Abbreviated, vertical symphysis						X
Geniohyoid pit				X	X	X
Position of mental foramen						X
Dental formula				X		
Premolar pattern		X		X	X	X
Molar pattern { Pr ^d Hy ^d Pa ^d Me ^d En ^d		X				X
Low trigonid						X
Lack of hypoconulid						
Brachydonty	X					X
Great posterior breadth of M						X
Long, vertical roots				X	X	X
P ₄ —4 roots, P ₃ —3 roots [P ₂ —2 roots]				X	X	X
Canine upright				X	X	X
Canine root deep						X
No diastema C-P ₂				X		

CONCLUSIONS

From the foregoing remarks it may be seen that *Amphipithecus* is a primate. Although it may be compared in a general way with various genera, it does not seem to show any particularly close affinities with any known form.

Of the primates, the lemuroids and tarsioids may be eliminated from among the groups to which *Amphipithecus* might show any close genetic affinities. There remain, consequently, the platyrrhine and the catarrhine primates, both of which groups contain genera in which certain features may show some resemblances to the form now under consideration.

Amphipithecus is like the platyrrhine monkeys in the presence of a second premolar. It shows resemblances to the cercopithecoids (particularly *Mesopithecus*) and to some of the anthropoids (particularly the gorilla) in the form of the last premolar. All in all, however, no very close comparisons can be made between the premolars of this new genus and any known primates, but generally speaking the greatest similarities are with the anthropoids. It shows resemblances to the gibbon, in a general way, in the form and structure of the first lower molar. On the other hand, this tooth in *Amphipithecus* is primitive, so that it resembles to some extent the same tooth in certain Eocene lemuroids. *Amphipithecus* resembles the higher primates, such as *Dryopithecus*, in the relatively great depth and thickness of the mandibular ramus and the brevity of the symphysis. It does not seem to resemble very closely any of the primates contemporary with it. It does not seem to be very close to *Pondaungia*, a supposed primate from the Eocene beds of Burma.

Thus it may be seen that the exact position of this new genus is difficult to define. It is probably an anthropoid primate, very possibly an early, in some ways specialized, relative of the higher anthropoids. It may in some way occupy a somewhat anomalous and separated position in the phylogeny of the anthropoid primates, but until further material is available, no definite conclusions can be made as to the precise affinities of this new genus.

As to the family relationships of *Amphipithecus*, two possibilities are evident. In the first place, this new genus might be placed in the family Simiidae because of its obvious affinities to *Parapithecus*, *Propliopithecus*, *Dryopithecus* and the other higher anthropoids. If this were to be done, however, the long established distinction of the anthropoids as primates having only two premolars would be broken down. For this reason the desirability of including *Amphipithecus* in the family Simiidae is questionable, even though the morphological details that characterize this genus make such a step a logical one.

In the second place, a new family or subfamily might be created to contain this single genus and species. But this would involve the founding of a new group of major taxonomic importance on very fragmentary evidence.

MEASUREMENTS

P ₃	Length	3.8	<i>Amphipithecus</i> A. M. 32520	<i>Pondaungia</i> (G. S. I. D203)	<i>Gorilla</i> A. M. CA501	<i>Hylobates</i> A. M. 70398	<i>Dryopithecus</i> ¹	<i>Pliopithecus</i> A. M. (cast)	<i>Propliopithecus</i> (After Schlosser)	<i>Parapithecus</i> (After Schlosser)	<i>Mesopithecus</i> A. M. (cast)	<i>Apidium</i> A. M. 13370	<i>Alouatta</i> A. M. 14169	<i>Ateles</i> A. M. 17218	<i>Pelycodus</i> A. M. 15624
	Width	4.2			15.5	7.8		5.7	4.0	3.0	8.0		5.3	3.5	4.3
	Height (crown)	4.0			14.5	4.7		5.4	4.0	2.8	6.3		6.4	4.4	3.0
P ₄	Length	3.6			13.0	5.5		5.6	4.0	3.8	8.5		6.0	3.0	4.9
	Width	4.6			12.0	5.3	9.0	5.4	4.0	3.3	6.0	3.8	6.1	3.7	4.5
	Height (crown)	4.0+			13.5	4.6	10.2	5.8	4.2	3.0	6.0	2.9	5.8	4.8	3.6
M ₁	Length	6.3			15.0	6.4	7.5	4.8	3.5	3.3	6.2	3.0	5.2	3.2	4.2
	Width (ant.)	5.2			12.0	4.9	11.5	6.1	5.2	4.0	7.0	3.9	7.7	5.3	5.2
	Width (post.)	5.9			13.2	5.4	10.3	5.3	5.0	3.7	5.8	3.2	5.9	4.9	4.1
	Height (crown)	3.6+			13.0	5.9	11.0				5.9	3.6	6.1	5.1	4.7
	Depth of mandible—M ₁	19.5			10+	4.0	..	3.2	3.4		4.0	2.5	4.5	3+	3+
	Thickness of mandible—M ₁	9.0			41.0	13.0	31.0	14.0	7.5	20.0	7.2	7.2	20.0	17.0	12.0
					20.0	6.0	19.0	6.9	8.2	5.5	7.2	3.9	6.5	6.0	6.5

¹ *D. frickae*

BIBLIOGRAPHY

- ELLIOT, D. G. 1912. 'A Review of the Primates.' Monographs, Amer. Mus. Nat. Hist., I-III.
- GREGORY, W. K. 1910. 'The Orders of Mammals.' Bull. Amer. Mus. Nat. Hist., XXVII, pp. 1-524.
1920. 'On the Structure and Relations of *Notharctus*, an American Eocene Primate.' Mem. Amer. Mus. Nat. Hist., (N. S.) III, Pt. II, pp. 1-243, Pls. XXXIII-LIX.
1922. 'The Origin and Evolution of the Human Dentition.' Baltimore.
1934. 'A Half Century of Trituberculy the Cope-Osborn Theory of Dental Evolution.' Proc. Amer. Philos. Soc., LXXIII, No. 4, pp. 169-317.
- MATTHEW, W. D. 1915a. 'Climate and Evolution.' Ann. New York Acad. Sci., XXIV, pp. 171-318.
- 1915b. (With Walter Granger) 'A Revision of the Lower Eocene Wasatch and Wind River Faunas.' Part II. Bull. Amer. Mus. Nat. Hist., XXXIV, Art. 9, pp. 311-328.
- 1915c. (With Walter Granger) 'A Revision of the Lower Eocene Wasatch and Wind River Faunas.' Bull. Amer. Mus. Nat. Hist., XXIV, Art. 14, pp. 429-483, Pl. xv.
- OSBORN, H. F. 1908. 'New Fossil Mammals from the Fayûm Oligocene, Egypt.' Bull. Amer. Mus. Nat. Hist., XXIV, Art. 16, pp. 265-272.
- PILGRIM, G. E. 1927. 'A Sivapithecus Palate and other Primate Fossils from India.' Pal. Indica (N. S.), XIV.
- SCHLOSSER, MAX. 1910. 'Über einige fossile Säugetiere aus dem Oligocän Ägypten.' Zoologischen Anzeiger, XXXV, N. 16, pp. 500-508.
1911. 'Beiträge zur Kenntnis der Oligozänen Landsäugetiere aus dem Fayûm (Ägypten).' Beiträge zur Pal. und Geol., XXIV, pp. 51-167, Pls. IX-XVI.
- STEHLIN, H. G. 1906. 'Die Säugetiere des Schweizerischen Eocäns.' Vierter Teil. Abhandl. Schweiz. Pal. Gesellsch., XXXIII.
1908. *Idem*, Fünfter Teil. Abhandl. Schweiz. Pal. Gesellsch., XXXV.
1910. *Idem*, Sechster Teil. Abhandl. Schweiz. Pal. Gesellsch., XXXVI.
1912. *Idem*, Siebenter Teil. Pt. I. Abhandl. Schweiz. Pal. Gesellsch., XXXVIII.
1916. *Idem*, Siebenter Teil. Pt. II. Abhandl. Schweiz. Pal. Gesellsch., XLI.
- SINCLAIR, W. J. 1914. 'A Revision of the Bunodont Artiodactyla of the Middle and Lower Eocene of North America.' Bull. Amer. Mus. Nat. Hist., XXXIII, Art. 21, pp. 287-295.

AMERICAN MUSEUM NOVITATES

Number 952

Published by
THE AMERICAN MUSEUM OF NATURAL HISTORY
New York City

October 1, 1937

THE COMPARATIVE OSTEOLOGY OF THE SWORDFISH (*XIPHIAS*) AND THE SAILFISH (*ISTIOPHORUS*)

By WILLIAM K. GREGORY AND G. MILES CONRAD

CONTENTS

	PAGE
INTRODUCTION.....	1
BODY-FORM AND FINS.....	4
SKELETON.....	8
Vertebral Column.....	8
Hypurals.....	13
Shoulder Girdle.....	13
Pelvic Girdle.....	13
Skull.....	13
CLASSIFICATION AND PHYLOGENY.....	21
BIBLIOGRAPHY.....	25

INTRODUCTION

Two complete skeletons and one immense skull of *Xiphias gladius* were secured near Louisburg, Nova Scotia, by the Michael Lerner Cape Breton Expedition of The American Museum of Natural History in July and August, 1936. One of these skeletons has been mounted for exhibition in the Museum's Hall of Fishes, while the other skeleton and skull have been deposited in the study collection of the Department of Ichthyology. A life-sized model (Fig. 1) of a North Atlantic record fish, weighing 601 pounds, caught by Mr. Lerner, was made by Al Pflueger of Miami, Florida, and has been placed on exhibition. Casts of this fish were made while it was still fresh and color notes were taken by Mr. Ludwig Ferraglio of the Museum's Department of Preparation.

Unlike most scombriforms, which are brilliantly colored, the color of the swordfish is a nearly uniform, dull muddy purple on the back and fins, the belly being a dirty white and the flanks bronze. Conceivably this dull color may have concealing value for the fish as it seeks its prey.

The swordfish follow the mackerel northward in July and August. Our party, however, did not find mackerel remains in their stomachs. We did find that the stomachs contained herring in abundance. Dr. C. J. Fish, the oceanographer, who has given close attention to the move-

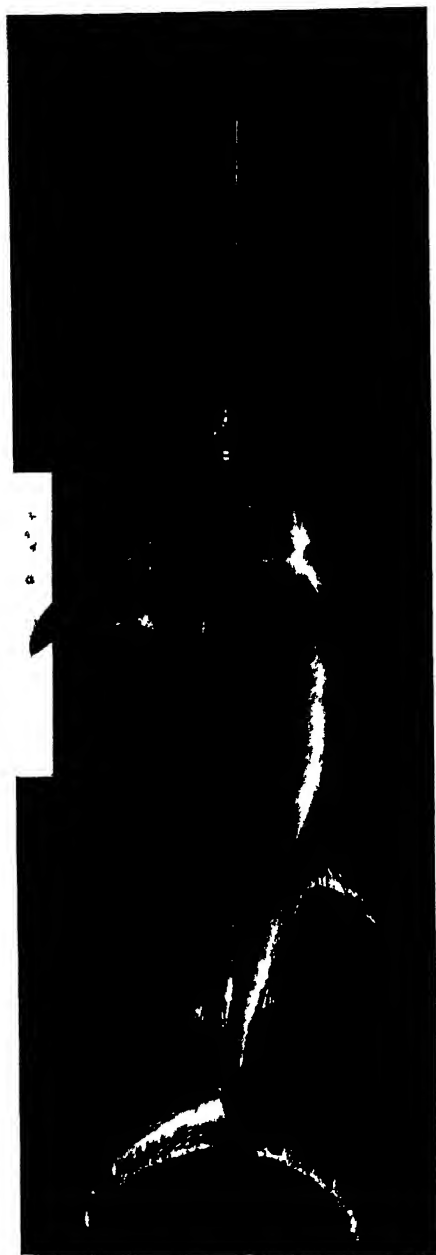


Fig. 1. Life-size model of swordfish.

ments of plankton and plankton-feeders, tells us he suspects that the herring feed at night when the plankton is near the surface and that the swordfish with their very large eyes see the phosphorescent glow caused by the movements of the herring in water containing light-producing organisms.

TABLE I.—Swordfish Measurements (in inches), Louisburg,
July 21-Aug. 6, 1936

Total length, tip sword to notch caudal	106.5	111	113	140.5 (est. 143.3)	151	141
Tip sword to eye	39	40	40.5	43 (est. 46)	55	46
Head without snout	13	—	14	17.5	18	17
Eye	3	—	3	4	4	4
Base to notch caudal	6	—	7	—	9	
Lower jaw projects beyond eye	5.75	—	6	—	7	
Tip lower jaw to angle gape	9.5	—	—	—	13½	
Tip lower jaw to angle gape groove	10.75	—	—	—	15¼	
Tip mandible to vent	—	—	—	62	57¾	55½
Depth body at dorsal axil	18	—	16.5	—	33	32
Thickness at dorsal axil	11	—	—	—		
Dorsal origin to tip	17	18	16.5	24	18½	
Pectoral	14.25	11.5	17	20	16	
Anal	7.5	—	11	—	15½	
Caudal lobe	22	22.5	22	27.5	26½	
Caudal spread	31	32	32	43	37½	
Origin to tip lower lobe second dorsal	3.5	—	—	—	4½	
Origin to tip lower lobe second anal	3.5	—	—	—	4½	
Length dorsal keel	7				8¼	
Depth dorsal keel	3				5	
Weight	225 lb. (est. total)	—	—	520 lb. (dressed net)	601 lb.	535 lb.

The expedition observed nothing contradictory to the common belief (Bigelow and Welsh, 1925, p. 242) that the swordfish pursues the herring, mackerel and cuttle-fishes and with sharp swings to the right and left strikes them with its sword and either cuts or stuns them. It certainly often swallows them whole, as noted by Raven and La Monte (1937) but some were found in the swordfish stomach with broken backs.

According to the fishermen the swordfish are ordinarily rather sluggish fish which cruise slowly at the surface, often with the dorsal fin cutting the water like a shark's. When harpooned, however, they develop great speed. Bigelow and Welsh (1925, p. 226) say that sometimes when struck the swordfish "sound with such speed and force as to drive the sword into the bottom" and come up with the mud still sticking to the sword. It has long been known that sometimes they drive the sword "right through the planking of a fishing vessel" (*ibid.*).

BODY-FORM AND FINS

The preceding notes suggest the reason for the streamlined torpedo-like body (Fig. 2). The greatest cross-section is just behind the dorsal fin and is an oval. There is a general parallelism with the mackerel sharks (*Isurus*, etc.) and especially with the ichthyosaurs.

The principal measurements of the fish from which the model was made were:

Total weight	601 lbs.
Length to notch of caudal fin (Pu)	151"
Greatest depth of body behind first dorsal	33"
Height of dorsal fin	18 $\frac{1}{2}$ "
Caudal spread (tt')	37 $\frac{1}{3}$ "

More detailed measurements, made by J. T. Nichols, are given in Table I.

An analysis of the body forms and fins of *Xiphias*, *Makaira* and *Istiophorus* by means of their inscribed rectilinear figures, as first used by Gregory (1928a, 1928b), reveals the following facts.

Xiphias gladius.—The body of *Xiphias* is dolichosomatic if the sword is included (since the vertical diameter is less than $1/5$ length Pp), but if the sword is not included, the body is mesosomatic, for the vertical diameter is then greater than $1/5$ of P'p. The head length is nearly one-half of the total length and may be considered macrocephalic. The forehead is flat to slightly concave and the entering angle is low.

The caudal fin is hypermacrocerca, the maximum spread (tt') being about $1\frac{1}{2}$ times (ad + av). The spread of the caudal exceeds that of the mackerel sharks in proportion to the rest of the body (cf. *Lamna*). The caudal fin may be termed leptopygidial (delicate peduncle) for pd + pv is less than $1/4$ (ad + av).

The dorsal fin is greater than $3/4$ the body depth and may be called

altiradial. It is situated very far forward, immediately above the pectoral fins and but a little way in front of the center of gravity of the entire fish. Probably the forward position and great height are advantageous not only in keeping the swordfish on a straight course but also in facilitat-

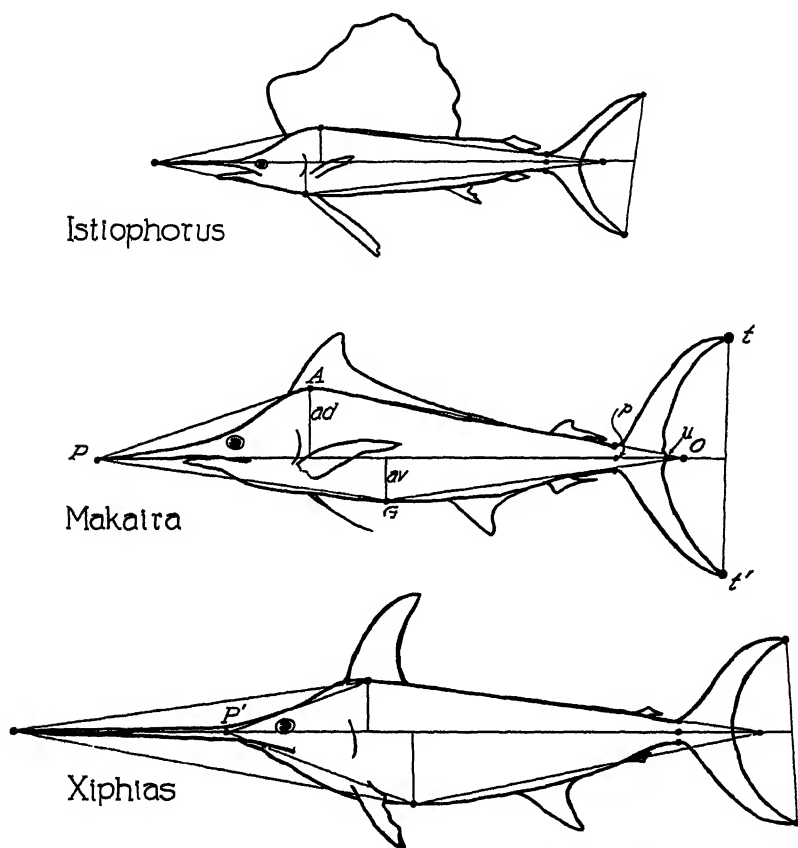


Fig. 2. Body-forms of swordfish, marlin and sailfish.

ing quick turning of the head. During lateral strokes of the sword the dorsal fin would probably be nearly stationary except for the free margin, but the side swing of the sword could be checked by sudden stiffening of the body and fins. If the swordfish were attacked by a large shark (as recorded by Bigelow and Welsh, p. 226), or by a killer whale, a direct ram-

ming action of the sword might be useful. From the large size and protruding position of the eyes it is not improbable that the thrusts and sweeps of the sword may be closely regulated by the varying angles and distances of the opposite eyes with reference to the moving prey. In any event we may be sure that the dorsal, pectoral and anal fins are important factors in quick maneuvering. Moreover, if the fish were cruising slowly at the surface, the protruding dorsal fin might well transmit the thrusts of the surface ripples and thus act as a wind-vane. Then if the fish swam into the wind it might be more likely to encounter shoals of plankton drifting before the wind with their accompanying herring and other fish.

Here is a possible explanation of the protrusion of the dorsal fin above the surface in sharks, sailfishes, marlins and swordfishes. Unfortunately the literature of fishing, so far as we have been able to examine it, affords only the fact that swordfishes do cruise slowly at the surface. When they get near to a school of small fish they may sound and then rise through the school "striking right and left with their swords and then turning to gobble the dead or mangled fish" (Bigelow and Welch, *op. cit.*, p. 225). We may be sure that the enormous eyes play a chief part in directing the sword play.

The large erect dorsal is also necessary in order to meet the thrusts of the enormous caudal fin. The soft dorsal, originally elongate, is now nearly absent except for a small vestigial posterior dorsal.

The anal fin, which is relatively large and conspicuous, doubtless cooperates with the anterior dorsal in steering, rising and falling. The posterior portion of the anal is vestigial.

The pectoral fins are of a fair size, inserted low.

The pelvic fins are lacking in *Xiphias*.

"*Makaira ampla*."—The body of *Makaira*, including the sword, is mesosomatic, for the body depth is greater than $1/5$ of the length. The head is macrocephalic but is considerably shorter than that of *Xiphias*. The entering angle is low.

The caudal fin is more than twice the depth of the body and thus is definitely hypermacrocercal. Its spread, however, exceeds that of the tail in *Xiphias*. The caudal peduncle is about $1/5$ of the body depth and is called leptopygidial.

The dorsal fin is altiradial but is somewhat less tall than that of *Xiphias*. It extends posteriorly quite far and is followed by the fairly well-developed posterior dorsal.

The anal fin, both anterior and posterior portions, is quite well developed.

The pectorals are inserted low and are comparable to those of *Xiphias*. Long and slender pelvic fins are present.

Istiophorus maguirei.—The body depth of *Istiophorus* is less than 1/6 of its length and the form is consequently dolichosomatic. The head is macrocephalic, proportionately much as in *Makaira*.

The caudal fin is hypermacrocercal, for tt' is greater than twice the body depth. This caudal is the largest proportionately in our series. The caudal peduncle of *Istiophorus* is nomopygidial.

The dorsal fin is more than 1 3/4 of the body depth and is thus superaltiradial. The posterior dorsal is well developed but in contrast to the sail is negligible. This immense anterior dorsal fin is the most conspicuous feature of *Istiophorus*.

The pectoral fins are small and the pelvics are fairly well developed and long.

The body-forms and fins of these three genera may be summarized as follows:

	<i>Xiphias</i>	<i>Makaira</i>	<i>Istiophorus</i>
Body-form	Dolichosomatic	Mesosomatic	Dolichosomatic
Head	Macrocephalic	Macrocephalic	Macrocephalic
Caudal fin	Hypermacrocercal	Hypermacrocercal	Hypermacrocercal
Caudal peduncle	Leptopygidial	Leptopygidial	Nomopygidial
Dorsal fin	Altiradial	Altiradial	Superaltiradial
Pelvics	Absent	Present	Present

At first sight one would be inclined to consider the marked general resemblance between the swordfish and the marlins as an evidence of fairly close relationship, but it is more probable that these two groups, the Xiphiidae and the Istiophoridae, are merely parallel families of scombriform fishes which were already well separated from each other in Upper Eocene or Lower Oligocene times.

As we shall see later, it is probable that in both families the dorsal fin originally extended nearly the whole length of the body, from the occiput to the caudal peduncle. In the true sailfishes (*Istiophorus*) the anterior part of the dorsal has become excessively large; in the marlins there has probably been a secondary reduction of this fin except at the anterior end. In the swordfish line only the anterior part became excessively elongate, the posterior part greatly reduced.

SKELETON

It seemed very desirable that the osteology of such an interesting form as *Xiphias* be described for it is so primitive geologically and yet so specialized structurally. However, it was not until after we had drawn our figures of the various elements of the skeleton that we found Cuvier and Valenciennes' (1831) beautiful figures of the skull of *Xiphias* and the skeleton of *Tetrapturus*. While their figures can scarcely be improved upon, we feel that a comparative discussion of the skeletons of *Istiophorus* and *Xiphias* is not uncalled for, because it may serve to bring out the significance of the habitus divergences of these two families, the Xiphiidae and the Istiophoridae (Table II). The literature of the Xiphiiformes deals chiefly with the taxonomy and problems of distribution of the group but there are numerous papers to be found that touch upon the osteology. Cuvier and Valenciennes (1831) give descriptions of the osteology of *Xiphias*, *Tetrapturus* and *Istiophorus*, but do not figure the latter; Brühl (1847) figures the skull and part of the vertebral column of *Tetrapturus* and a dorsal view of the skull of *Xiphias*; Knox (1870) describes briefly a few skeletal details of *Istiophorus* and figures the first three abdominal vertebrae and the dorsal fin rays with their corresponding inter-neurals; Lütken (1877) figures the entire skeleton of *Tetrapturus*; Goode (1883) figures the skeletons of *Xiphias*, *Istiophorus* and *Tetrapturus*; Regan (1909) illustrates a structural series with diagrams of the rostral region in several scombroids, including *Istiophorus* and *Xiphias*; and finally, Gregory (1933) figures the neurocranium of *Istiophorus*.

The drawings are the work of Mrs. Helen Ziska and the photographs were taken by the Museum's photographic department.

The skeleton of *Xiphias* as mounted (Fig. 3) is particularly notable for its relatively stout column with but few segments. The stout block-like centra are necessary to meet the powerful thrust of the large tail and the adverse leverage brought about by the long rostrum. Also remarkable are the shortness and poor development of the ribs. The loss of pelvic fins was noted above but here we see that pelvic bones are lacking as well.

THE VERTEBRAL COLUMN.—Taking into consideration the close parallelism of the Xiphiiformes, it is of particular interest to note the striking heritage differences between *Xiphias* and *Istiophorus* as displayed in the vertebral column.

Comparison of the two skeletons reveals a strong anteroposterior emphasis of the centra and their processes in *Istiophorus* and a moderate dorsoventral growth in *Xiphias*. Cuvier and Valenciennes (1831) and



Fig. 3. Skeleton of swordfish.

Brühl (1847) figure the vertebral column of the marlin, *Tetrapturus*, which agrees perfectly with that of *Istiophorus*, so that further discussion of the column of the sailfish will apply also to that of *Tetrapturus*.

A vertebral count gives *Xiphias* fifteen pre-caudals and eleven caudals, including the tail centrum, to make a total of twenty-six vertebrae. The specimen of *Istiophorus* which was available for our study had twelve pre-caudal and twelve caudal vertebrae, making a total of twenty-four. In *Istiophorus* prominent anterior neural zygapophyses form a slot into which the flattened, laminated and expanded neural spines fit (Fig. 4). The anterior zygapophyses overlap about two-thirds of the preceding neural spine in the anterior pre-caudals and increase in relative length as they pass rearward until in the posterior pre-caudals the zygapophysis is projected beyond the point at which the neural spine of the preceding vertebra arises. This forms a very rigid spinal column and seems to permit free movement in only the dorso-ventral plane. The posterior neural zygapophyses are barely produced. The ribs articulate with the centra in front of slightly produced transverse processes.

Contrasted with these unusual specializations of the sailfish are the conservative, more generalized conditions found in the swordfish. The centra of *Xiphias* (Fig. 4) have a cuboid appearance as compared with the elongate, rather hour-glass shape of those in the sailfish. The neural spines of *Xiphias* are not expanded and are well produced dorsally. The anterior neural zygapophyses spring obliquely upward rather than horizontally forward as they do in *Istiophorus*, and overlap slightly the neural spines of the preceding vertebrae. The overlap of the neural spine by the following anterior zygapophysis seems to be characteristic of the Xiphiiformes, for Kishinouye's (1923) figures of mackerel and tuna skeletons do not show this condition. The posterior neural zygapophyses of *Xiphias* are strongly produced and, in marked contrast to *Istiophorus*, are almost as long as the anterior zygapophyses. The ribs of the swordfish are inserted on short, stubby transverse processes. As noted above, the number of pre-caudal vertebrae is markedly different in the two genera.

The caudal vertebrae of *Istiophorus* add to their firmly jointed dorsal side an haemal arch, which is practically an upside-down version of the neural arch (Fig. 4). With the exception of the first caudal vertebra, which has no anterior haemal zygapophysis, the remaining caudals have a pair of anterior haemal zygapophyses which together form a slot for the haemal spines of the preceding vertebrae. Among the other scombroids such a tendency is noted in *Auris*. These anterior haemal zygapophy-

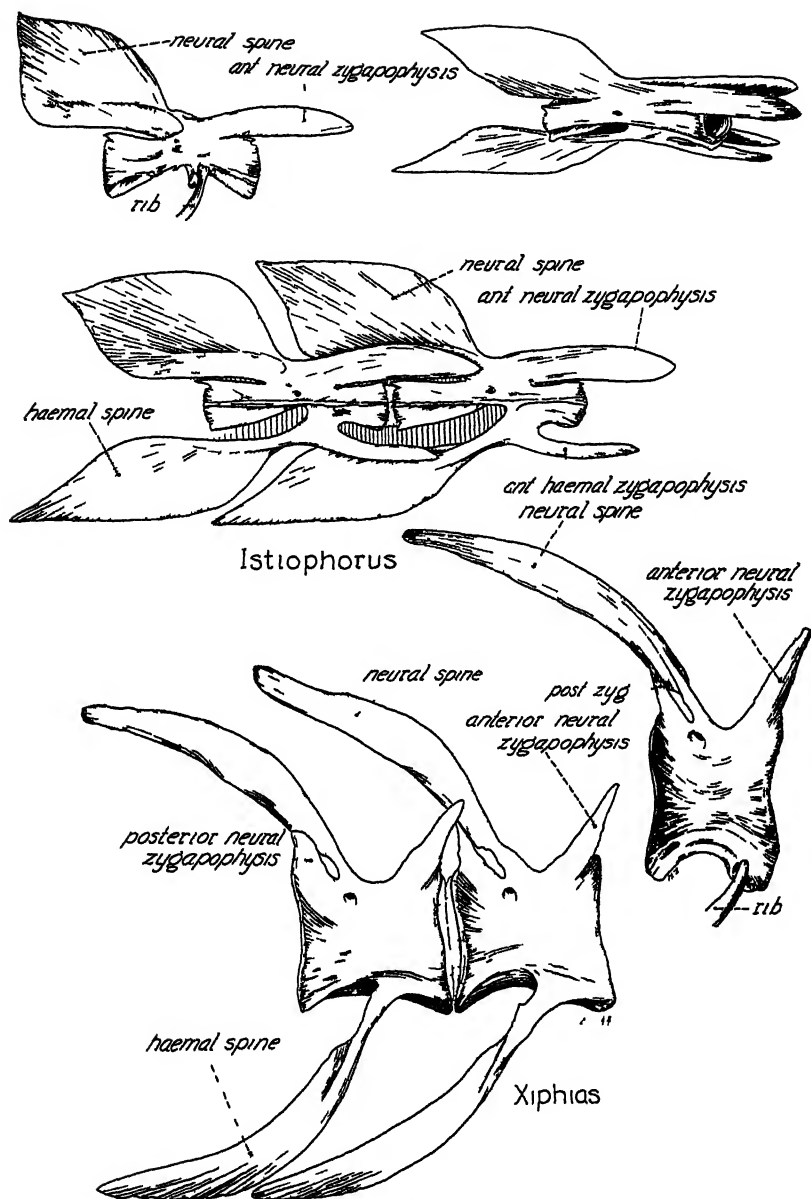


Fig 4 Abdominal and anterior caudal vertebrae of *Xiphias* and *Istiophorus*

ses are not as long as their corresponding neural elements, but add appreciably to the lateral stiffening of the column. This mutual dovetailing of the vertebrae results in an almost complete elimination of lateral movement of one segment upon the other and probably favors use of the entire column as a spring under tension in the horizontal plane. It may perhaps be due to this peculiar spring-like character of the backbone that sailfishes are able to "walk on their tails," that is, to shoot out of the water and propel themselves forward for a short distance by strong movements of the caudal fin against the water.

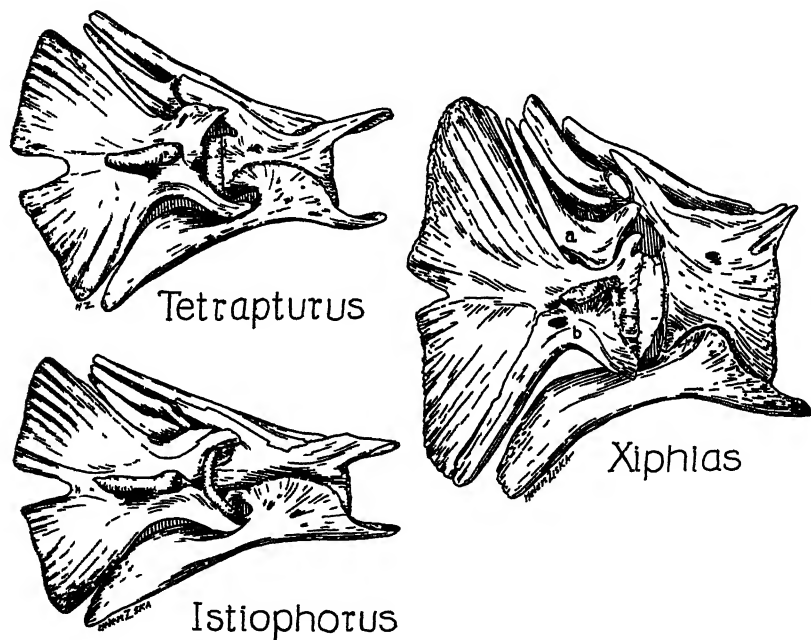


Fig. 5. Hypural fan and supporting elements.

In *Xiphias* the caudal vertebrae become slightly longer than deep, but the neural spines continue as in the pre-caudals, becoming smaller toward the tail. The anterior and posterior neural zygapophyses grade off posteriorly in keeping with the neural spines. Ventrally haemal arches are present and, like the neural spines, the haemal spines are not expanded. The anterior and posterior haemal zygapophyses are very slightly produced. The vertebrae of *Xiphias* seem to be movable on each other in both the dorsoventral and lateral directions.

HYPURALS.—The tail complex (Fig. 5) of *Xiphias gladius* seems to be more closely associated with the condition in the Istiophoridae than with any of the other groups of mackerel-like fishes. Allowing for the general anteroposterior emphasis of the post-cranial skeleton in the sailfish, the tail vertebrae and the arrangement of the hypurals are very similar in the two families. Two free hypurals (Fig. 5, *a*, *b*) are noted in *Xiphias*, but evidence of their fusion with the other hypurals may be seen in *Istiophorus*. *Tetrapturus* carries this fusion still further. The Istiophoridae have the lateral hypural crest very well developed, whereas that of *Xiphias*, while prominent enough, is much less so. Study of Kishinouye's (1923) plates shows an almost complete lack of a deep notch in the posterior hypural complex of the other scombroid fishes but this notch is quite prominent in the Xiphiiformes.

SHOULDER-GIRDLE.—Just as there is a tendency toward an anteroposterior emphasis in the axial skeleton of the Istiophoridae, there is also such a trend in the shoulder-girdle. The posterior angle of the cleithrum is extended somewhat more in *Istiophorus* than in *Xiphias*. The anterior border of the coracoid grows forward until it touches the cleithrum in *Istiophorus*, but not in the swordfish. In cross section the supracleithrum of the sailfish would be a much flattened oval with the greatest diameter lying along the anteroposterior plane, while in the swordfish the cross section would be roughly circular. The posttemporal of *Istiophorus* is incipiently three-pronged as in percoid fishes, while that of *Xiphias* is definitely two-pronged.

PELVIC GIRDLE.—There is no trace of pelvic bones or fin in *Xiphias*, while in *Istiophorus* these elements are well developed.

SKULL.—The skull of *Xiphias gladius* (Fig. 6) is approximately seven times as long as it is deep, whereas that of *Istiophorus* is about six times as long as deep. The long "broadsword" of *Xiphias* and the more delicate "rapier" of *Istiophorus* are the dominant and conspicuous features of the two skulls.

Throughout the scombroid series the suborbital bones are rather weak and in *Xiphias* the reduction is almost complete. Although they were lost in our specimen, Cuvier and Valenciennes (1831) figure them as a row of thirteen minute bones not articulated with each other but extending from the sphenotic process to the base of the parethmoid. Goode's (1883) figure of *Xiphias* does not include these suborbitals. In *Istiophorus* the suborbitals, while reduced from the primitive condition (as seen in *Scomber*), are relatively much larger than those of *Xiphias*. As a substitute for the lack of protection afforded the eye by the sub-

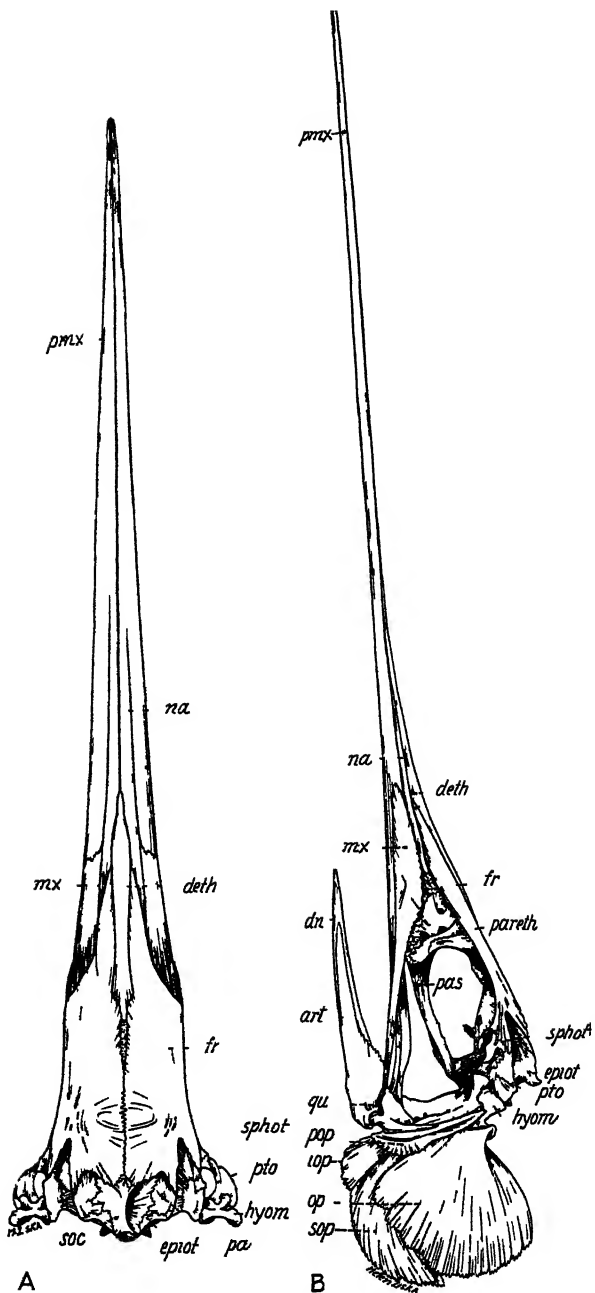


Fig 6 Skull of *Xiphias* A, dorsal, B, left lateral view

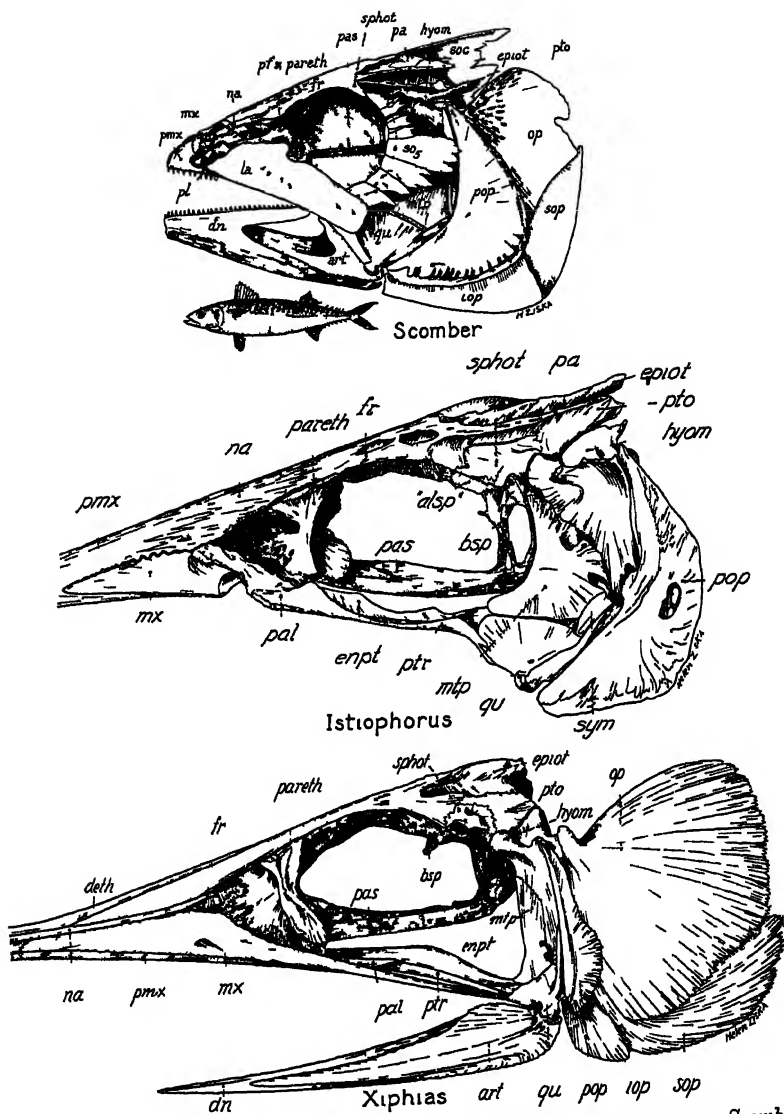
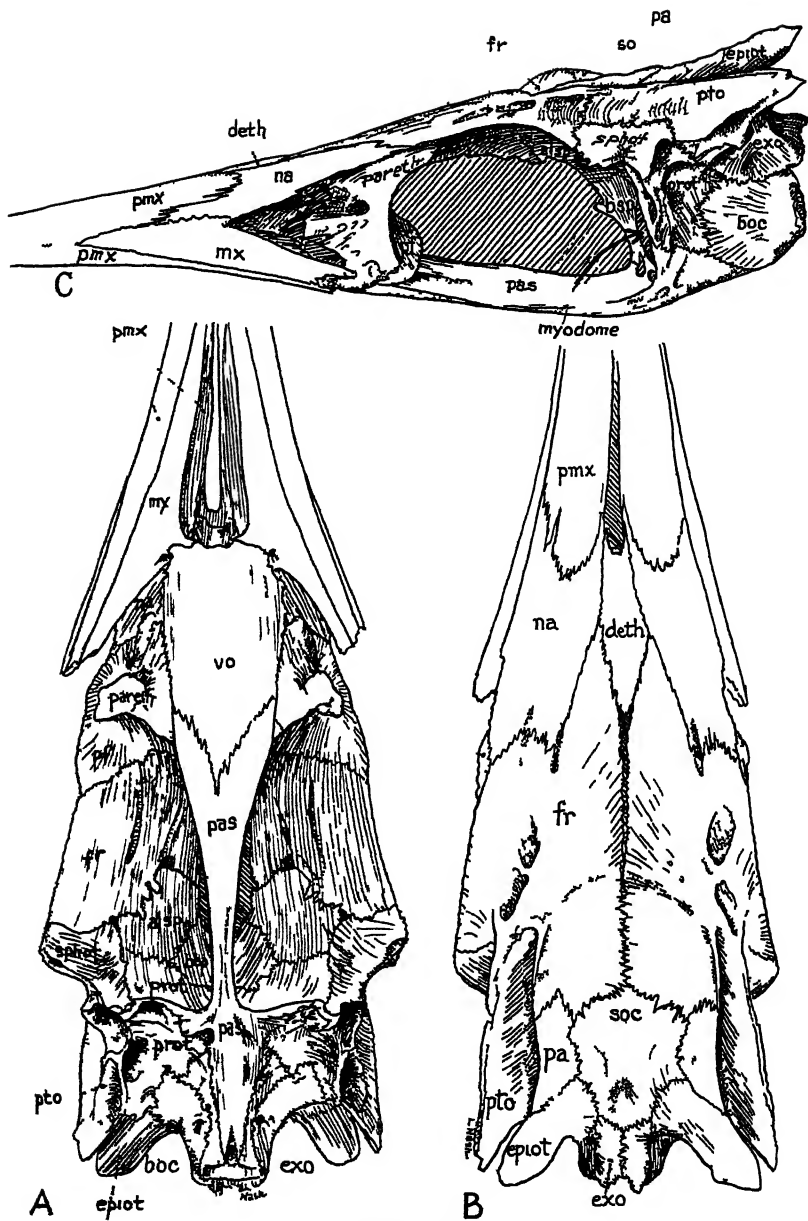


Fig 7 Skulls of *Scomber*, *Istiophorus* and *Xiphias*, lateral views *Scomber*
after Allis (1903)



Istiophorus

Fig 8 Skull of *Istiophorus* A, under side, B, top, C, left side After Gregory (1933)

orbitals, a heavy, solid sclerotic ring is developed in *Xiphias* (Fig. 3), *Istiophorus* and probably in the other Xiphiiformes.

The metapterygoid (Fig. 7), which is broad and quite prominently separate in *Istiophorus*, becomes narrow and closely articulated to the hyomandibular in *Xiphias*. The symplectic is well developed and normal in position in *Istiophorus*, but in *Xiphias* it is so well articulated to the quadrate as to give the appearance of being fused to it. The quadrate of the swordfish presents in side view the typical equilateral triangular shape, whereas in the sailfish it becomes expanded anteriorly, along with the lower border of the metapterygoid, to form a more or less quadrilateral outline. The significance of these differences is discussed below (p. 20).

In both *Istiophorus* and *Xiphias* the parasphenoid (Fig. 8) flares abruptly to meet the broad and prominent vomer. In the sailfish the basisphenoid bone (Figs. 7, 8) is a well-developed Y-shaped bone, the leg of which articulates with the parasphenoid. Although Cuvier and Valenciennes (1831) state, "Je ne trouve pas de sphénoïde antérieur dans mes squelettes," we find that in the swordfish (*Xiphias*) the characteristic Y-shaped basisphenoid is formed but, unlike that of *Istiophorus*, the leg of the Y does not reach ventrally far enough to articulate with the parasphenoid (Fig. 7).

The form and sculpture of the parethmoids in both of these genera is very similar to that of *Scomber*, the typically primitive scombriform fish.

The well-developed opercular series of bones of *Xiphias* (Fig. 7) have their posterior edges serrated and are rather similar in pattern to those of the sailfish. Their large size in relation to the rest of the skull is a scombriform heritage and is probably, according to Gregory (1933, p. 309), "conditioned . . . by the voluminous development of the branchial apparatus."

In 1909, Regan figured a structural series of scombriform rostra, starting with *Acanthocybium*, passing through *Istiophorus* and *Xiphias*, and culminating in the Eocene *Xiphiorhynchus*. Of this series we have had only two for study, *Istiophorus* and *Xiphias*. After long study of the formation of the sword in *Istiophorus* it became more and more apparent that certain of the elements had been wrongly homologized by Regan. In *Istiophorus* what he has called the frontal is really a separate bone (Figs. 7, 8) lying anterior to the frontal and dorsad to the nasal opening. This "frontal" of Regan has been rightly called nasal by Gregory (1933, p. 317, Fig. 197). What then is the element labelled "nasal" by Regan? The maxillae do not form a part of the dorsum of the sword for they lie lateral and posterior to the premaxillaries. Gregory (1933) labelled the

element ventral to the nasal cavity as the lacrymal. However, it now appears possible that the lacrymal has become fused to the maxilla, for the mesial portion of this bone is certainly the seat for the characteristic anterior hook of the palatine over the maxilla (Fig. 9). In addition, the mesial ventral surface of this lacrimo-maxillary element abuts directly on to the vomer as does a typical maxilla. With the maxilla and nasal accounted for, we still lack a homologue for the greater portion of the sword. We believe that the element labelled "nasal" by Regan in *Istiophorus* is nothing more than the ascending branch of the premaxilla, so that the sword is made up entirely of the premaxillae in the sailfish.

The formation of the sword in *Xiphias*, however, still remains for consideration (Figs. 6, 7). There are two possibilities: either the sword may be made up as in the sailfish or it may be made up of other elements and merely parallel that of *Istiophorus*. If the nasals in *Xiphias* have been pushed forward and outward laterally by the forwardly expanding fron-

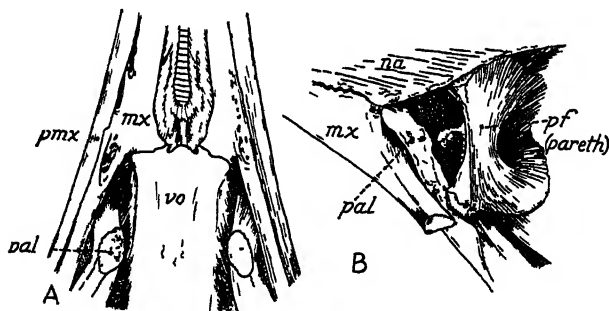


Fig. 9. *Istiophorus*: relations of maxilla to surrounding elements. A, palatal view; B, oblique left side view.

tals until they are now represented by a mere sliver situated above the narial cavity but covered dorsally by the overhanging frontals, then the elements of the sword may be homologized with those of *Istiophorus*. However, all the authorities who have concerned themselves with this problem (Cuvier and Valenciennes, 1831, Brühl, 1847, and Regan, 1909) name the dominant element of the *Xiphias* sword the nasal. Structurally this is the same element which we have identified in *Istiophorus* as the ascending ramus of the premaxilla.

The bone that we identify as nasal retains part of its primitive association with the narial cavity for it enters the cavity anteriorly. There

is also no evidence of any other nasal elements. If therefore we are to homologize the elements of the sword with those of the sailfish, we must acknowledge its identity as the nasal. Thus in the sailfish (Fig. 8) the enlarged nasals form the main part of the broad roof of the skull above the narial cavity and they serve to stiffen the base of the sword on the dorsal surface, whereas in *Xiphias* (Fig. 6) the narrow nasals have grown forward along with the premaxillae, meeting in the mid-line on the dorsal surface of the sword itself in front of and laterally to the elongate dermethmoid. Apparently the entire rostrum of the swordfish must be stronger and better braced than that of the sailfish.

In both types the greatly enlarged and expanded ethmoid complex must play an important part in acting as a combined thrust block and buffer between the cranium and the ram. The ethmoid complex as a whole is nearly filled with a mass of thin spongy bone, the interior of which reminds one of a wasp's nest. The innumerable small cells seem to form a reservoir of oily substance, which in life is probably enclosed in a continuous chamber under relatively high pressure. As seen from above, after the removal of the surrounding roofing bones the ethmoid complex would be roughly wedge-shaped, the point of the wedge being directed anteriorly. In *Istiophorus* the middle portion (mesethmoid, dermethmoid) ends in front and below in a Y-shaped column which rests firmly on the broadly expanded platform of the vomer. The broad rear of the wedge is formed by the paired parethmoids (Fig. 8) (prefrontals), which meet in the mid-line in front of the orbits, of which they form the front pillars; they rest below upon the vomer and palatines. Each one is pierced by the large olfactory foramen. In *Xiphias* the spongy mass is of great size but otherwise we detect no important difference from *Istiophorus* except that the mesethmoid is greatly prolonged in front and its spongy part more expanded.

The mandible of *Xiphias* (Fig. 7) is very short in proportion to the length of the skull and does not extend as far as the anterior edge of the maxilla. In *Istiophorus*, however, it extends relatively much farther forward, although it does not approach the tip of the rostrum. The lower jaw of the sailfish differs from that of *Xiphias* in having a prementary bone. Although Cuvier and Valenciennes do not figure a prementary bone in *Tetrapturus*, Regan lists it as one of the family characters of the Istiophoridae. Both *Xiphias* and *Istiophorus* possess a sesamoid articular bone on the mesial surface of the articular (Starks). Although the pattern of the lower jaw is very similar in both there is a marked dorsal convexity in that of *Istiophorus*.

The cranial vault in *Istiophorus* is wide transversely and shallow dorso-ventrally. Its roof is formed by the frontals, sphenotics, pterotics, parietals, epiotics and supraoccipital, the latter extending far forward to meet the frontals. This roof is strongly built and braced to resist the posterodorsal stream of stresses from the rostrum; it also supports the strong suspensorium of the oralo-branchial complex. The sides of the cranial vault are formed chiefly by the "alisphenoids," proötics and opisthotic-exoccipitals. The latter in turn form a stiff secondary floor for the brain-stem and rest firmly on the very strong vertically deepened basioccipital. The proötics are continued ventrolaterally into large stiff buttresses, which in turn border the capacious chamber for the eye muscles, and are continuous below with ascending wings of the parasphenoid. Both the basioccipital and the proötic buttresses receive the posteroventral thrusts from the vertically arched and very stiff keel bone (parasphenoid), which also supports the slender stem of the basisphenoid. The keel bone, which is stiffened against buckling by its triangular mid-section, thus transmits and distributes part of the backward thrusts from the rostrum as well as the forward thrusts from the vertebral column. The tripartite occipital condyles are very strongly braced to resist both fore-and-aft pressures and torsion.

In *Xiphias* the conditions of the cranium are nearly as described above except that the entire cranial vault is shorter anteroposteriorly and wider transversely, the lateral ventral buttresses of the proötics around the myodome have the anterior borders reflected and deficient toward the outer margins; the ventral stem of the basisphenoid is not ossified. On the roof of the occiput the narrow fossae for the mm. levator arcus palatini, dilatator operculi, levator operculi and trapezius are all relatively small.

The sphenotic and pterotic facets for the hyomandibular in *Istiophorus* are extended anteroposteriorly and the wide suspensorium is directed mostly downward. In *Xiphias* the pterotic facet is shorter and tilted backward and upward, so that the suspensorium is directed more backward; correlated features are the anteroposterior shortness of the metapterygoid, quadrate and preopercular, and the small size of the mandible in *Xiphias*.

We have examined the habitus features of the skulls of the sword-fish and the sailfish which separate them so distinctly from the remaining scombriform fishes. Where is the scombroid heritage? As a typical "primitive" of the group, *Scomber* (Figs. 7, 10) serves admirably. The dorsal aspect of the skull of *Scomber* shows the same occipital pattern of

elements as in *Xiphias* or *Istiophorus*. The arrangement of the crests is similar in all, differing only in proportions. The relatively long premaxillaries are showing a tendency to extend themselves forward. The narrow finger-like nasals overlap the premaxillaries. With the forward growth of the premaxillaries the nasals are ready to follow in *Xiphias*, while in *Istiophorus* the nasals widen laterally but retain their primitive position as in *Scomber*.

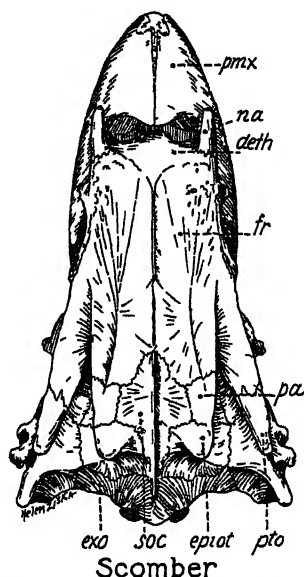


Fig. 10. *Scomber*, top view of skull.

In side view the skull of the mackerel (Fig. 7) differs markedly from *Xiphias* in the large size of the suborbitals. The lacrymal, plastered over the maxilla in *Scomber*, perhaps has become fused to it in *Xiphias*. The opercular series is large and dominant in both. The parethmoids are strikingly alike in all of these genera. The reduction of some of the elements in the Xiphiiformes, notably the pterygoids, is probably the result of altered stresses developing with the evolution of the sword.

CLASSIFICATION AND PHYLOGENY

The Xiphiidae and Istiophoridae, although generally parallel families with more or less divergent habitus details, are yet tied together in a

TABLE II.—Chief Differences in the Skeletons of the Swordfish, the Sailfish and the Mackerel

	<i>Xiphias</i>	<i>istophorus</i>	<i>Scomber</i>
SKULL			
Suborbitals	Minute; not articulated with eye	Fairly well developed; touching each other	Fairly well developed; touching each other
Metapterygoid	Closely articulated to hyomandibular	Separated by cartilage from hyomandibular	Separated from hyomandibular
Symplectic	Almost fused to quadrate	Normal, not fused to quadrate	Normal, not fused to quadrate
Quadrate	Triangular shape in side view	Quadrilateral in side view	Triangular shape in side view
Basisphenoid	Log of "Y" does not articulate with parasphenoid	Does articulate with parasphenoid	Does articulate with parasphenoid
Nasals	Very narrow, prolonged on dorsum of sword	Broad, short; do not form part of sword	Small, projecting forward and slightly overlapping pmx.
Mesethmoid	Narrow, elongate	Short	Broad
MANDIBLE			
Pre-dentary bone	Not present	Present	Not present
SHOULDER-GIRDLE			
Posttemporal	Two-pronged	Incidentally three-pronged	Three-pronged
PELVIC GIRDLE	None	Well developed	Well developed
VERTEBRAL COLUMN			
Number of vertebrae			
Pre-caudals	15	12	14 (<i>japonicus</i>) ¹
Caudals	11	12	17 (<i>japonicus</i>) ¹
Shape of centra	Cube-like	Elongate; hour-glass shape	Elongate cube, with some of the hour-glass character ¹
Anterior neural zygapophyses	Placed obliquely; long	Horizontally placed, very long	Horizontally placed; fairly long ¹
Posterior neural zygapophyses	Strongly produced	Barely produced	Produced slightly ¹
Neural spines	Not expanded, produced dorsally	Laminated, expanded anteriorly	Not expanded; produced dorsad ¹
Anterior haemal zygapophyses	Very slightly produced	Horizontal, quite long	Horizontally placed; quite long ¹
Posterior haemal zygapophyses	Very slightly produced	Not produced	Slightly produced ¹
Haemal spines	Not expanded	Laminated, expanded posteriorly	Not expanded ¹
Hypurals	Similar to those of <i>Istiophor</i> but with two free hypurals	Free elements fused	Fusion quite thorough ¹

common scombroid heritage, which, as recognized by Regan (1909, p. 70), includes the following among other characters:

- (1) Maxillaries more or less firmly attached to the nonprotractile premaxillaries which are typically produced and pointed anteriorly.
- (2) Cranium with orbito-rostral portion elongate and postorbital portion abbreviate.
- (3) Parietals separated by supraoccipital.
- (4) No orbitosphenoid.
- (5) Basisphenoid present.
- (6) Proötics giving rise to an osseus roof for the myodome.
- (7) Vertebral column of solid centra, which are coössified with the arches.

The generic "habitus" characters in the skeletons of *Xiphias*, *Istiophorus* and *Scomber* are set forth in Table II.

It has long been known that the swordfish (*Xiphias gladius*) is a highly specialized end-stage of the scombriform series. Cuvier and Valenciennes (1831) so considered it and Regan, more recently (1909), concurs by placing it in the division Xiphiiformes along with the living marlins and sailfishes (Istiophoridae) and three extinct families (Palaeorhynchidae, Blochiidae and Xiphiorhynchidae). All these families date back to Eocene times, while *Acestrus* (Xiphiidae) and *Xiphiorhynchus* are found in Lower Eocene deposits. The Scombridae also begin in the Lower Eocene, whereas the other scombroids do not appear until the Oligocene period. The fact that the structurally primitive family (Scombridae) and its highly specialized offshoots (Xiphiiformes) were living side by side in early Eocene times seems to indicate that the latter stemmed off from the scombrids in the Cretaceous.

The Eocene fish, *Palaeorhynchus*, with its high elongate dorsal, its neural and haemal spines with thin posterior laminar expansions and well-developed pelvic fins, seems to point the way toward the Istiophoridae. *Palaeorhynchus* must have its high number of vertebrae (from 50 to 60) reduced, however, before it attains the *Istiophorus* condition.

On the other hand, the Upper Eocene form *Blochius*, placed by Smith Woodward (1901) in the Blenniiformes but subsequently referred to the Xiphiiformes by Regan (1909), seems to be near the stem of the Xiphiidae. In its lack of pelvic fins and girdle, stout and few-segmented column, unexpanded neural and haemal spines and its short feeble ribs, *Blochius* compares quite favorably with *Xiphias*.

Gregory (1933) published a pictorial phylogeny of the scombriform fishes in which *Xiphias* was depicted as branching from the istiophorid line relatively late in the history of the group. From the evidence assem-

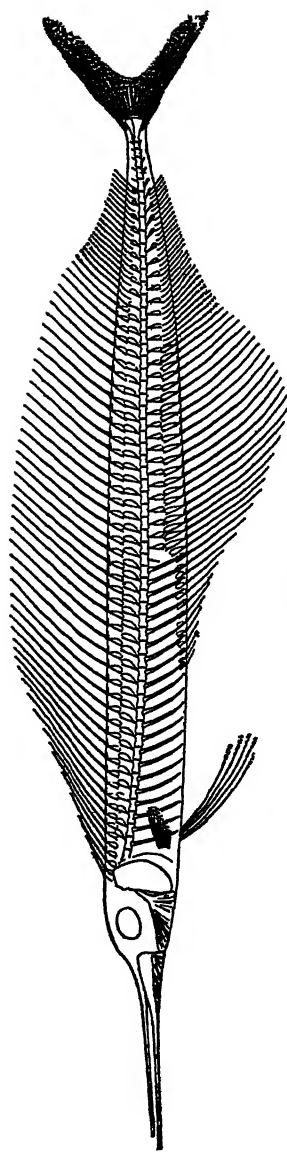


Fig. 11

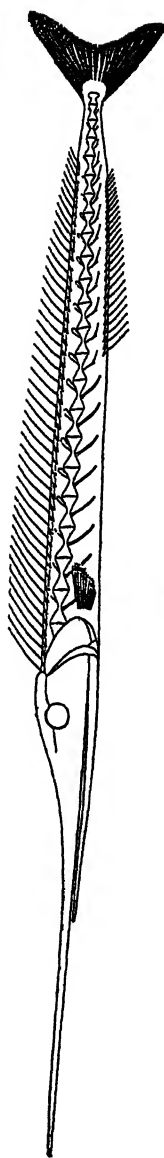


Fig. 12

Fig. 11. Reconstruction of the Lower Oligocene sailfish, *Palaeorhynchus glariusianus*. After Smith Woodward (1901). About 1/5 natural size.

Fig. 12. Reconstruction of the Lower Eocene swordfish, *Blochius longirostris*. After Smith Woodward (1901). About 1/6 natural size.

bled in this paper it appears, however, that the foregoing idea was probably incorrect and that we must adopt Regan's view (1909) that the Xiphiidae and Istiophoridae run back separately to basal Eocene times, parallel but distinct.

BIBLIOGRAPHY

- ALLIS, E. P. 1903. 'The skull and the cranial and first spinal muscles and nerves in *Scomber scomber*.' Jour. Morph., XVIII, No. 2, pp. 45-328.
- BIGELOW, H. B., AND WELSH, W. W. 1925. 'Fishes of the Gulf of Maine.' Bull. U. S. Bureau of Fisheries, XL, Part I, pp. 1-567, 278 figs.
- BREDER, C. M., JR. 1926. 'The Locomotion of Fishes.' Zoologica (New York), IV, No. 5, pp. 159-297, 83 figs.
- BRÜHL, C. B. 1847. 'Anfangsgründe der vergleichenden Anatomie aller Thierklassen.' Erster Abschnitt, 'Die Skelettlehre der Fische.' Lief 1-3. Wien. IV, 254 pp., 19 pls. 4 to and obl. folio.
- CUVIER, G., AND VALENCIENNES, A. 1831. 'Histoire naturelle des poissons.' Tome 8°. Paris.
- GOODE, G. B. 1883. 'Materials for a history of the sword-fish.' Rept. U. S. Fish Comm., (1880), Part 8, pp. 289-386, 24 pls.
- GREGORY, WILLIAM K. 1928 a. 'Studies on the body-forms of fishes.' Zoologica (New York), VIII, No. 6, pp. 325-421, Figs. 117-155.
- 1928 b. 'The body-forms of fishes and their inscribed rectilinear lines.' Palaeobiologica, I. Bd., pp. 93-100, Pl. VIII.
1933. 'Fish skulls; a study of the evolution of natural mechanisms.' Trans. Amer. Philos. Soc., N. S., XXIII, No. 2, pp. 75-481, 302 figs.
- JORDAN, D. S., AND EVERMANN, B. W. 1926. 'A review of the giant mackerel-like fishes, tunnies, spearfishes and swordfishes.' Occ. Papers, Calif. Acad. Sci., XII, 113 pp.
- KISHINOUE, K. 1923. 'Contributions to the comparative study of the so-called scombroid fishes.' Jour. Coll. Agriculture, Imp. Univ. Tokyo, VIII, No. 3, pp. 293-475.
- KNOX, F. J. 1870. 'On the New Zealand sword-fish.' Trans. New Zealand Institute, II (1869), pp. 13-16.
- LÜTKEN, C. F. 1877. 'Fire højsfiske. 1. Svaerdfiskene.' Tidsskr. Pop. Fremdstilling Naturvidensk., (5) IV, pp. 241-263.
- NICHOLS, J. T., AND LA MONTE, F. R. 1937. 'Notes on swordfish at Cape Breton, Nova Scotia.' Amer. Mus. Novitates, No. 901, 7 pp.
- RAVEN, H. C., AND LA MONTE, F. R. 1937. 'Notes on the alimentary tract of the swordfish (*Xiphias gladius*).' Amer. Mus. Novitates, No. 902, 13 pp.
- REGAN, C. T. 1909. 'On the anatomy and classification of the scombroid fishes.' Ann. Mag. Nat. Hist., (8) III, pp. 66-75.
- STARKS, E. C. 1901. 'Synonymy of the fish skeleton.' Proc. Wash. Acad. Sci., III, pp. 507-539.
1926. 'Bones of the ethmoid region of the fish skull.' Stanford Univ. Pub., Biological Sciences, IV, No. 3.
- WOODWARD, A. S. 1901. 'Catalogue of the fossil fishes in the British Museum.' Printed by Order of the Trustees. xxxviii, 636 pp., 19 pls.

AMERICAN MUSEUM NOVITATES

Number 953

Published by
THE AMERICAN MUSEUM OF NATURAL HISTORY
New York City

October 7, 1937

MORE COMPLETE REMAINS OF A CHELONIAN, *SYLLOMUS CRISPATUS* COPE, FROM THE MIOCENE OF VIRGINIA

BY CHARLES T. BERRY

In 1896 Cope¹ described a new genus and species of Cheloniidae from the Miocene beds on the Pamunky River, Virginia. This new turtle, *Syllomus crispatus*, was based upon two fragments of carapace and part of a humerus. No additional material belonging to this species has been recognized until, on June 14, 1936, the present author collected a nearly complete specimen of *S. crispatus* from a Miocene exposure on the Virginia side of the Potomac River. This additional material greatly extends our knowledge of Cope's species although altering only slightly some of his generalized generic characters.

During the month of June the author visited Horsehead and Stratford Cliffs (better known under the collective name of Nomini Cliffs), Westmoreland County, Virginia. The purpose of the trip was to obtain additional remains, if possible, of *Peritresius virginianus* which had been obtained from Horsehead Cliffs the previous June.² Only scattered plates of this turtle were found while a nearly complete specimen of *S. crispatus* was collected about 50 feet south, and at an elevation of about 7 feet above beach level, from the type locality of *Peritresius virginianus*.

SPECIMEN.—The specimen consists of the nuchal, first to seventh neurals inclusive, and the second postneural; first suprapygal, and portions of all the costals of the carapace. The plastron is represented by a portion of the left hyoplastron, right and left hypoplastron, and right and left xiphiplastron. Also portions of first, second and eleventh right peripherals, first to sixth inclusive and eleventh left peripherals, and pygal, also portions of both right and left scapular, pubis, coracoid, ischium, a bone of the skull and several vertebrae.

LOCALITY.—The remains were collected in a bed about 7 feet above the beach at the southeastern end of Horsehead Cliffs, Westmoreland County, Virginia.

HORIZON.—The age of the beds exposed in these cliffs has been long

¹ Cope, E. D., 1896, 'Sixth Contribution to the Knowledge of the Marine Miocene Fauna of North America,' Proc. Amer. Philos. Soc., XXXV, pp. 139-140.

² Berry, C. T., and Lynn, W. G., 1936, 'A New Turtle, *Peritresius virginianus*, from the Miocene of Virginia,' Proc. Amer. Philos. Soc., LXXXVI, No. 2, pp. 175-190.



Fig. 1.

- A Carapace of *Syllomus crispatus* (A M No 1661) $\times 4/11$
 B Ischium $\times 1$
 C. Second right peripheral, inside view. $\times 5/1$
 D. First right peripheral, outside view. $\times 5/1$
 E Centrum and neural arch of seventh cervical vertebra. $\times 1$

disputed. The last work of Mansfield in 1932² states that there is exposed the upper part of the Calvert, all of the Choptank, and the lower part of the St. Mary's formations. The matrix in which the specimen was found is a blue-gray diatomaceous clay.

CARAPACE.—The outline of the carapace is oval being more blunt at the anterior than at the posterior end. The sculpturing on the carapace is very similar to that which is found on *P. virginianus* with the exception that on *S. crispatus* the grooves are wider at the expense of the ridges. Whether this difference is a generic one or due to age is uncertain. That *S. crispatus* is a somewhat older individual than *P. virginianus* is brought out by the several pitted areas on the carapace of the former. In general the sculpturing in the central portion of the costals parallels the plate while near the lateral edges it runs at right angles to the intercostal sutures. On the neurals the arrangement becomes very fine and irregular.

The carapace (Fig., A) is flatly arched transversely, while the curvature of the anterior end is greater than the flattened posterior portion. Crossing the first, second and third right and left costal plates is a very faint, low ridge about one and one-eighth inches from the neurocostal suture and parallel to it. This ridge which is more prominent on the first and third than on the second is lacking on the remaining costals. Running down the center of the first to fifth neurals is a low median keel which reaches its maximum on the posterior part of the nuchal plate and decreases posteriorly. The sulci can be easily traced in the median region of all the costal plates, but become indistinct near the lateral ends of the plates. The costoperipheral sulci can be observed crossing the distal ends of the fourth and sixth right costals and the second to sixth left costals.

The visceral surface of the carapace is very incomplete having crumbled away upon collection and preparation of the specimen. The proximal rib ends are represented by only rounded knobs, as are the neural arches of the neural plates.

The greatest width of the carapace, taken in a straight line from the posterior corners of the right and left fourth costal is 288 mm., excluding the peripherals. The actual length including the nuchal and supygal is 428 mm. Greatest estimated width including the peripherals is 378 mm., estimated length including pygal is 540 mm.

The costoperipheral suture is present on the first to sixth right and left costals in all cases where the distal margin of the plates is preserved.

² Mansfield, Stephenson and Cooke, 1932, Int. Geol. Cong. 16, Guidedook No. 5, Excursion A-5, pp. 25-28.

Posterior of the sixth costal the distal ends do not possess any evidence of a suture. Whether this is due to the preservation of the specimen or the absence of such suture cannot be ascertained, but in all probability the peripherals did not contact the costals, for on the posterior portion of both the right and left eleventh peripherals a suture is present for only about 25 mm. The remaining portion forming a thin smooth edge. In order to maintain the marginal curvature of the carapace with that of the eleventh right and left peripherals and pygal it is necessary that the posterior costals not be united with the peripherals by a costopheral suture. The peripherals are also united to the costals by gomphoses of the rib ends with the exception of the first right and left peripherals.

Detailed description of the individual bones of the carapace will be omitted, Table I of their measurements being substituted. The epidermal sulci indicate that *S. crispatus* resembled the existing genus *Chelonia* in having five vertebral shields and four pairs of costal shields. Measurements of which are also included in Table I.

In addition to these carapace plates there was found an oval shaped plate (Fig. 2. D) whose exact location is uncertain. From the sculpturing upon the surface of this plate and its curvature it belongs to the posterior portion of the shell. This sculpturing is very similar to that which the pygal possesses. The interior surface is pitted with minute oval and circular holes irregularly arranged. Sutures are present on two of the diagonal corners in varying amounts. These sutures do not fit with any that have been found on the other carapace bones. In all probability this plate flanks the suprapygal. The longest axis of the plate is 60 mm. and the shortest 38 mm.

The pygal has the outline of a truncated triangle, the lateral sides joined by sutures to the eleventh right and left peripherals. The base of the triangle forms the posterior margin whose center is indented by a V-shaped sinus which is flanked on both sides by rounded lobes. The broken anterior margin possesses sutures. The dorsal surface, which is arched, is finely sculptured similarly to both eleventh peripherals, while the concave ventral surface is indefinitely sculptured. Near the margin on the posterior portion of the plate there are situated two semi-circular pitted areas which were probably caused by some infective organisms. The greatest width of the plate in a straight line across the posterior portion is 59.5 mm., greatest length 40 mm. and greatest thickness 9 mm.

PLASTRON.—The plastron was greatly crushed and the plates were very poorly preserved, so much so that only portion of these bones can be described. The reconstruction of these plates shows a curvature of ap-



Fig. 2 *Syllomus crispatus* Cope.

- A Left hypoplastron, inside view $\times^{3/11}$
- B Right coracoid $\times 1$
- C Left scapula $\times^{3/4}$
- D Extra plate from posterior region of carapace $\times^{3/7}$.
- E Right scapula $\times^{3/4}$
- F Right xiphiplastron $\times 1$

TABLE I

	Length (middle)		Width (greatest)	
	Bones	Scutes	Bones	Scutes
Nuchal	46 mm.		?	
Neurals				
1	43 mm.	80 mm.	27 mm.	60 mm.
2	47 mm.	92 mm.	26 5 mm.	55 mm.
3	48 mm.	92 mm.	27 5 mm.	53 mm.
4	46 mm.	?	26 mm.	47 mm.
5	44 mm.		25 mm.	
6	39 mm.		24 mm.	
7	25 mm.		22 mm.	
8	X		X	
Post neurals				
1	X		X	
2	17 mm.		20 mm.	
Suprapygals				
1	30 mm.		?	
Costals				
1 R	?	?	67 mm.	?
2 R	?	?	50 mm.	97 mm.
3 R	?	?	49 mm.	90 mm.
4 R	?	?	51 mm.	?
5 R	?		45 mm.	
6 R	?		50 mm.	
7 R	106 mm.		41 mm.	
8 R	?		?	
1 L	?	?	?	?
2 L	127 mm.	122 mm.	57 mm.	95 mm.
3 L	139 mm.	127 mm.	57 mm.	90 mm.
4 L	142 mm.	95 mm.	49 mm.	?
5 L	139 mm.		48 mm.	
6 L	126 mm.		41 mm.	
7 L	105 mm.		38 mm.	
8 L	?		49.5 mm.	

Measurements of individual bones and scutes of carapace (X indicates absence of plate; ? indicates complete measurement unobtainable).

proximately 126 degrees for the left hyoplastron. On none of the plates is there any evidence of sulci. None of the marginal processes were preserved intact, and the hyohypoplastral sutures have been destroyed.

The left hyoplastron (Fig. 3, A) is the best preserved of all the plastron plates. It is irregular in outline, somewhat rectangular; it varies in thickness being thickest near the center of the anterior margin, thinning near margins. Greatest length of plate is 105 mm., greatest width 95.5 mm. and greatest thickness 5 mm.

The right hypoplastron (Fig. 3, C) is represented by a small fragment from the posterior portion of the plate. This piece is only 45 mm. in length, 57.5 mm. in width and 6 mm. thick at greatest measurements. The left hypoplastron (Fig. 2, A) which is about twice the size of the right fragment represents the anterior portion of the plate. This fragment is 112 mm. broad, 76 mm. in length and 4 mm. thick at greatest measurements.

Only small portions of the right (Fig. 2, F) and left (Fig. 3, G) xiphiplastrons were preserved. These bones are very thin becoming thicker in posterior region where dorsal side of plate is arched. These plates are the only ones of the plastron which show any sculpturing, which is present on the posterior portion. The right xiphiplastron is 86 mm. long, 45 mm. broad and 4 mm. thick. The left xiphiplastron is 58.5 mm. long, 35.5 mm. broad and 4 mm. thick.

PERIPHERALS.—The peripherals preserved well enough for identification were the first, second and eleventh right and the first to sixth and eleventh left ones. Besides these numerous other incomplete pieces were found.

Only a small portion of the first right peripheral (Fig. 1, D) was preserved, consisting of a part of the outer margin and the posterior corner, possessing some suture. A similar fragment of the second right peripheral (Fig. 1, C) was found showing on the inside the open pit for the rib end.

The eleventh right peripheral is rectangular in outline except for the outer anterior corner which is lacking. Both anterior and posterior margins sutured while the outer margin forms a thin edge. The dorsal costal margin is uneven, the anterior portion is a thin straight edge for 21.5 mm. then there is an offset of about 2 mm. and the remaining 25 mm. is sutured. The sculpturing on the dorsal surface is pronouncedly finer than that which is found on the first two peripherals. Most of the ventral surface is lacking, exposing the sockets for the rib ends in cross section. The greatest length of the plate is 52 mm., greatest width 37 mm.

The first left peripheral is rectangular in outline and is flat. The anterior and posterior margins as well as the costal margins possess sutures, the outer margin rounded. The dorsal surface of the plate, which is twisted on the diagonal, is covered by irregular sculpturing. The interior surface is smooth being covered by numerous small holes with a radiating pattern from a place near the outer margin in the center of the plate. The plate thickens near costal margin. Greatest length of plate is 58.5 mm., greatest width 32.5 mm., greatest thickness 4.5 mm. and thinnest 2.5 mm.

The second left peripheral is irregular in outline, the outer surface curved inward. The anterior margin is partly broken and both costal and posterior margins possess sutures. The dorsal surface of the plate, which is irregularly sculptured, curves down forming the outer margin. Across the anterior portion of the plate is a shallow groove which indicates the intermarginal sulcus. The interior surface is irregularly pitted in the anterior portion near the outer margin where there is a shallow pit for the rib end. The plate is much thicker near the costal margin, being thinnest in the curvature of the plate. The greatest length of the plate is 51 mm., greatest width 42 mm., greatest thickness 5 mm. and thinnest 3 mm.

The third left peripheral, which is somewhat crushed, is irregular in outline. The anterior, posterior and costal margins sutured. The latter margin is sigmoid in shape. The outer margin curves under and forms the ventral surface. The dorsal surface is covered by irregularly arranged tubercles, the ventral surface being covered by shallow grooves and ridges. The inner surface of the plate is irregularly pitted with small holes, greater portion of surface covered by clay to strengthen plate. The plate is thickest near the posterior costal corner. Greatest length of plate is 51 mm., greatest width 40 mm., thickest 5 mm.

The fourth left peripheral is rectangular in outline. The anterior and costal margins are sutured, the posterior one imperfectly preserved. The costal margin has a broad shallow sinus in center. Outer margin curves under and forms ventral surface. The dorsal surface is irregularly sculptured having a radiating structure from a place near the center of the outer margin. Crossing anterior part of plate is faint intermarginal sulcus. Sculpturing on ventral surface destroyed. The remains of the inner surface, which is exposed, is pitted by small holes. Portion of rib end imbedded in clay. Greatest length of plate is 52 mm., and width 39 mm.

The fifth left peripheral is represented by a portion of the dorsal surface and a portion of the ventral surface held together by clay. The costal margin possesses sutures, other margins too badly preserved to distinguish. Dorsal surface is irregularly sculptured.

The sixth left peripheral is badly crushed and its identification depends upon a small portion of the costal margin, which is sutured, uniting to the fifth costal. The posterior margin is sutured. The dorsal surface is faintly sculptured as is the ventral surface.

The tenth left peripheral is represented only by a small posterior fragment whose sutures unit with the eleventh left peripheral.

The eleventh left peripheral is similar in outline to the right one, being however more complete. The costal margin is sutured for only 14 mm. of its 34 mm. length, the remaining portion forming a thin edge. The ventral surface of the plate still retains faint evidence of sculpturing. The inside surface possesses two conical sockets for the rib ends (the anterior socket is the deepest), both being in the posterior portion of the plate. Greatest length of plate 54 mm., greatest width 36 mm.

The fact that the first six left peripherals join the costals by a costal-peripheral suture as well as by gomphoses of the rib ends, and that the posterior portion of the eleventh right and left peripherals join the rest of the carapace by sutures while their anterior portions do not definitely exclude this specimen from the genus *Peritresius* as does the fact that two ribs unite by gomphosis to the eleventh peripherals. These facts which exclude the specimen from *Peritresius* place it without question under the genus *Syllomus* as partly characterized by Cope in 1896. Likewise the presence of the two rib sockets in the eleventh peripherals makes it differ from the living Loggerhead, *Caretta caretta* (Linnaeus) which possesses only one such socket.

OTHER BONES.—The centra of the sixth (Fig. 3, E) and seventh (Fig. 1, E) cervical vertebrae were preserved. The corners as well as the hypapophyses of both centra are broken off. Nearly all of the anterior end of the sixth centrum is lacking, however, enough still remains to show that this end was concave. The posterior end is flat. Attached to the anterior portion of the seventh centrum is half of the neural arch, which is badly preserved. The anterior end of this centrum is flat while the posterior end is convex. These two centra unite extremely well considering their condition.

MEASUREMENTS OF CENTRA

	Sixth	Seventh
Length	22 mm.	21 mm.
Width	21 mm.	18 mm.
Diameter of anterior concavity:		
Vertical	?	11 mm.
Horizontal	?	15 mm.
Diameter of posterior convexity:		
Vertical	10 mm.	?
Horizontal	17 mm.	?

(? indicates complete measurement unobtainable)

The sacral vertebrae (Fig. 3, F) are represented by two crushed centra and the right pair of short ribs, all embedded in clay. It seemed advis-

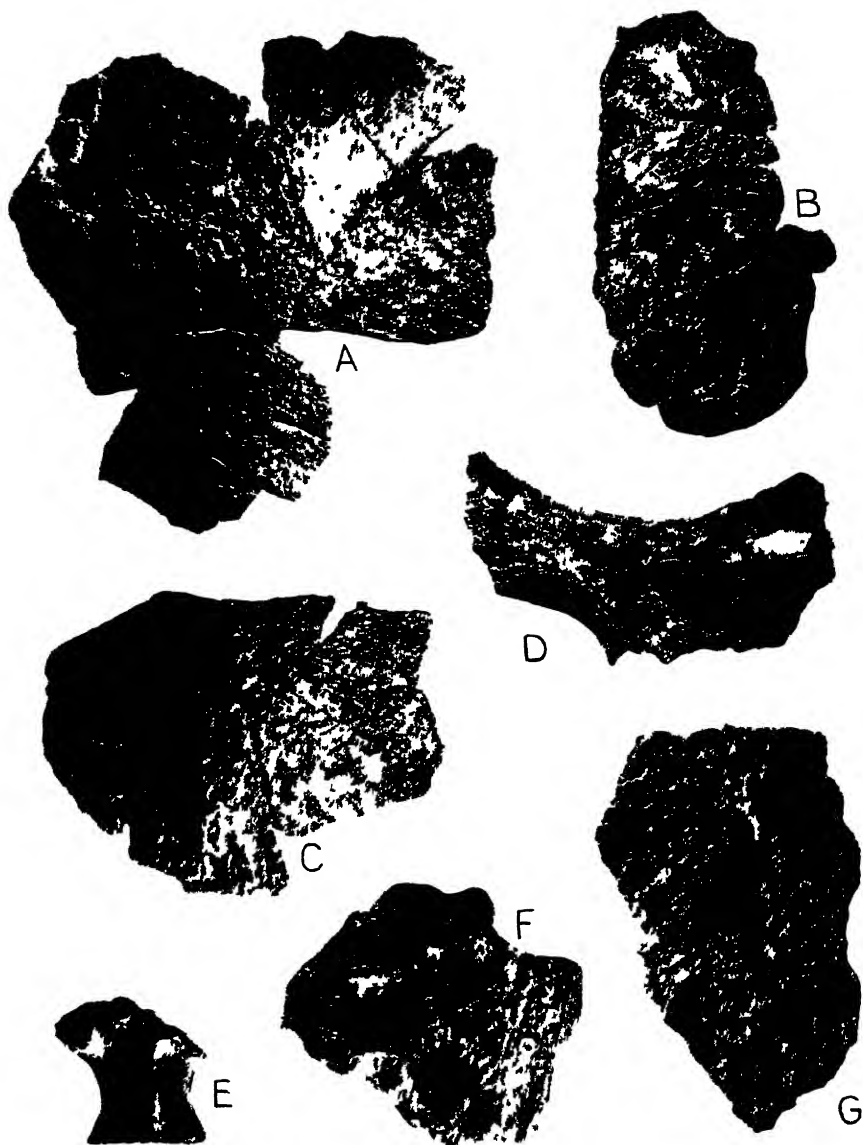


Fig. 3. *Syllomus crispatus* Cope.

- A. Left hyoplastron. $\times^{9/13}$.
- B. Left parietal. $\times 1$.
- C. Right hypoplastron. $\times 1$.
- D. Right pubis. $\times 1$.
- E. Centrum of sixth cervical vertebra. $\times 1$.
- F. Centra of sacral vertebra embedded in matrix. $\times 1$.
- G. Left xiphiplastron. $\times 1$.

able to leave these bones in the clay due to their state of preservation, thus only their dorsal surface is exposed. The anterior end of the centrum of the first sacral vertebra is lacking. The posterior end of the second centrum is flat, being irregularly pitted. The dorsal surface of the centra is uneven with a low, sharp, narrow ridge crossing both bones. The first right rib which is only 5 mm. broad at its proximal end increases to over 11 mm. at its distal end. The second right rib is much smaller than the first, being only 4 mm. broad at proximal end and increasing to a little over 6 mm. at its distal end. The surface of the ribs is, in general, smooth being slightly depressed in central region. At the anterior end of the specimen is part of neural arch exposed in cross section.

The pectoral girdle is represented by portions of the right (Fig. 2, E) and left (Fig. 2, C) scapula and the anterior portion of the right coracoid (Fig. 2, B). The right scapula, the most complete, has the ends of the distal rod and the proscapular lacking while the glenoid fossa is too crushed to distinguish. On the portion of the left scapula the proscapular end is better preserved and shows region where the fibro-cartilagenous plate unites with the bone. At the end of the distal rod the fine grooves and ridges which parallel the bone are preserved. The right coracoid is represented by only a portion of the anterior head. Conditions of preservation of the glenoid articulating surface prevents measurements. Entire length of fragment of coracoid is 77 mm.

The pelvic girdle is represented by fragments of the pubis (Fig. 3, D) and ischium (Fig. 1, B). The pectineal process and a portion of the proximal part of the right pubis are preserved. The bone is thin, in general thickening in the proximal portion. The smallest distance across the pectineal process is 15 mm. The fragment of the right ischium is too broken to distinguish any of its features. Its longest measurement is 29 mm.

The skull is represented by a portion of the left parietal (Fig. 3, B). This identification is based upon the suture along one edge, the curvature of the inner surface, and the thinness of the bone. This fragment is so badly crushed that portions of the clay were left adhering to strengthen the specimen. The suture along the median edge is 37 mm. long and 7 mm. thick at greatest measurement. The greatest length of the bone is approximately 60 mm. while its width is about 34 mm.

DISCUSSION.—In Cope's original description he placed more emphasis upon the humerus than upon the pieces of the carapace, but it is remarkable that the present find complements his conception of this species and the genus which he set up for it. The author had the privilege of study-

ing Cope's type last year and it is regrettable that in the present find that the humerus was lacking, so that no comparison could be made. Cope draws the conclusion that there are two lateral keels upon the carapace of *S. crispatus*. In this he seems to be right but these keels do not traverse the entire length of the carapace. Instead they die out posterior to the third costals. As to the median keel he cannot say because of the absence of the "vertebral bone." In the present specimen there is a low median keel crossing the first five neurals. Both of these keels are not prominent in the recent find. In regard to the contact of all the peripherals with the costals, Cope apparently went beyond the facts at hand and entered the field of conjecture. In the recent find there is evidence that the first six peripherals joined the costals by a costalperipheral suture as did part of the eleventh. However the anterior portion of the eleventh peripherals do not possess any suture, thus proving that some of the plates from the sixth to eleventh did not unite with the costals. Unfortunately just which ones did or did not cannot be stated for the plates in question were not preserved.

This lack of a costalperipheral suture in the posterior portion of the carapace raises the question as to whether the presence of this suture is an indication of the age of the individual. This could only be proved by a great number of specimens which as yet have not been found. If this suture is indicative of age, then the genera *Syllomus* and *Peritresius* are the same. It is concluded that the present specimen of *S. crispatus* is of an old turtle as indicated by the condition of its carapace, whereas the specimen of *P. virginianus* originally described is that of a very young individual. A similarity between these two genera appears in all features except the costalperipheral suture and the arrangement of the pygal plates.

The present specimen of *Syllomus crispatus* has been deposited in The American Museum of Natural History along with Cope's type, and has received the Cat. No. 1661.

AMERICAN MUSEUM NOVITATES

Number 954

Published by
THE AMERICAN MUSEUM OF NATURAL HISTORY
New York City

October 14, 1937

NOTES ON THE CLARK FORK, UPPER PALEOCENE, FAUNA

BY GEORGE GAYLORD SIMPSON

The first and, as yet, the largest Clark Fork collection was made by American Museum parties under Dr. Walter Granger principally in the years 1911-1912. The mammals then found, and a few from later years, were included in their Lower Eocene revision by Matthew and Granger (see references at end of paper) and most of the Clark Fork species have been named, described and figured by them. Of the few groups not included in their work, the tillodonts are described in this paper, the uin-tathere was described by me (Simpson, 1929) and the coryphodont does not merit full description but is mentioned below.

A few additions to the fauna were made by Jepsen (1930A), and as Princeton parties under him are continuing work in that region further additions may be expected.

The high quality of the work already done makes thorough revision unnecessary, and the continuance of field work makes a general review premature, but these same circumstances do make it advisable to fill the few gaps in publication of our collection and to make its data as complete and accessible as possible.

The tillodonts are here discussed for the first time and two other forms which Matthew did not, but which I do, consider as new are named and diagnosed. Aside from these additions to the faunal list, this paper is devoted to a more exact characterization of such Clark Fork animals as are well enough represented to make this possible, and to an analysis of their precise relationships to their Sand Coulee¹ and Gray Bull relatives.

¹ Jepsen (1930B) notes that *Homogalax* occurs in the Sand Coulee and therefore suppresses the name and includes the corresponding strata in the Gray Bull. That it is very close to the typical Gray Bull both faunally and stratigraphically is clear, and Jepsen's attitude seems justified on his more recent data. At the same time the Sand Coulee fauna was not wholly defined by Granger on the absence of *Homogalax* but also by the generally slightly less advanced character of its mammals. This is confirmed by our collections. Several instances of the distinction between Sand Coulee and Gray Bull mammals of the same species or genus are incidentally mentioned in the comparisons in this paper, and others exist. Such distinctions are slight but they are increasingly important as this part of the sequence is studied in greater detail, and they can only be made if some exact records of horizon, such as those proposed by Granger, are maintained in field records and in publications, as far as possible. Whether in this case this be done by using the name Sand Coulee, or some other, such as Lower Gray Bull, is immaterial. Since, however, previous publication has used Lower Gray Bull in another sense while most of the animals of the base of the Lower Eocene have already been published as the Sand Coulee fauna, it appears somewhat confusing to change these usages at present. It is evident from Jepsen's work that Sand Coulee does not apply to a major unit nor have the scope of a formation in common usage, but it is distinguishable by careful methods, and an unambiguous, preferable, alternative notation for these minor horizons is not available at present. I therefore shall continue to use Sand Coulee until or unless such a notation is proposed.

In practically all older paleontological work and for the greater part of that recently done, comparisons are made on the basis of individual specimens only. Even when groups of specimens are available and are compared, the comparison is in fact of the several individuals of the group and not of the group itself as a unit. Where it is possible, in this paper the method used is to compare the groups as such, to use the individual specimens only as representatives of a group rather than thinking of the group as secondary and the individuals as the essential units. Although the distinction may seem unduly subtle, it is in fact fundamental. This approach obviously is not of universal applicability, but where it can be used to advantage it seems absolutely essential for the placing of paleontology on a more exact, more objective and less intuitive basis. It is in many cases the only way in which the minor distinctions essential for progress in the present stage of study can be determined and evaluated on sound principles. Among other important points, it is doubtful whether such differences as that between the Sand Coulee and Gray Bull faunas can be clearly recognized in any other way. Distinctions of this sort involve, for instance, the characterization of units of about the value of subspecies in Holocene taxonomy. Subspecies can rarely or never really be recognized in vertebrate paleontology, whether they be successive or geographic, except by statistical methods, since these furnish the only means other than intuition (thoroughly unreliable in this respect) for distinguishing real group differences from individual variation.¹

CLARK FORK MAMMALIAN FAUNAL LIST

MULTITUBerculata

Ptilodontidae

Parectypodus sp. (auct. Jepsen, 1930)

?INSECTIVORA

Apheliscidae

Apheliscus nitidus, new species

Nictitheriidae

Gen. et sp. indet.

PRIMATES

Plesiadapidae

Plesiadapis dubius (Matthew, 1915)*Plesiadapis cookei* Jepsen, 1930

Carpolestidae

Carpolestes dubius Jepsen, 1930

¹ The constants and methods here employed are in wide use in other fields, although few paleontologists have hitherto used them. All are given in the following manual:

Fisher, R. A., 1925, "Statistical methods for research workers." Biological Monographs and Manuals, V.

They are also explained and their peculiar adaptability to paleontological work discussed in a paper on the use of numerical data soon to go to press.

TILLODONTIA

Esthonychidae

Esthonyx ? *bisulcatus* Cope, 1874*Esthonyx grangeri*, new species*Esthonyx latidens*, new species

PALAEANODONTA

Metacheiromyidae

Palaeonodon parvulus Matthew, 1918

CREODONTA

Arctocyonidae

Thryptacodon antiquus Matthew, 1915

Mesonychidae

Dissacus praenuntius Matthew, 1915

Oxyaenidae

Oxyaena aequidens Matthew, 1915*Dipsalidictis platypus* Matthew, 1915*Dipsalodon matthewi* Jepsen, 1930

Miacidae

Didymictis protenus proteus, new subspecies

CONDYLARTHRA

Phenacodontidae

Phenacodus primaevus cf. *primaevus* Cope, 1873*Phenacodus primaevus* cf. *intermedius* (Granger, 1915)*Ectocion osbornianus ralstonensis* (Granger, 1915)*Ectocion parvus* (Granger, 1915)

Hyopsodontidae

Haplomylus speirianus (Cope, 1880)

PANTODONTA

Coryphodontidae

Coryphodon sp.

DINOCERATA

Uintatheriidae

Probathyopsis praecursor Simpson, 1929*Probathyopsis* sp. (auct. Jepsen, 1930)

Parectypodus and *Carpolestes* are not present in the American Museum collection but are recorded by Jepsen (1930A). *Plesiadapis cookei* is represented in our collection only by an incomplete upper incisor, the affinities of which were unrecognizable when Matthew wrote, and this species is likewise based on Jepsen's material. *Dipsalodon* is doubtfully represented in our collection by a few uncharacteristic fragments. Jepsen (1930A, p. 493; 1930B, p. 129) notes the occurrence of a second, more primitive species of *Probathyopsis*, but he has not named or further characterized it.

Most of the Clark Fork animals belong to typically Paleocene groups and have ancestors or close relatives in the Torrejon and its equivalents. Some of the characteristic Middle Paleocene forms had, however, died out, or at least are not represented in the fairly large Clark Fork collections (e.g., the previously very abundant peripitychids). Although the fauna is thus essentially Paleocene in origin and affinities, almost all its genera and larger groups survived into the true Eocene. The Sand Coulee-Gray Bull fauna is essentially that of the Clark Fork greatly enriched by additions probably due in greatest part to immigration. At least one order (Perissodactyla), several families (e.g., Adapidae) and numerous genera (e.g., *Hyposodus*) are common in the Gray Bull (plus Sand Coulee) but are as yet unknown in the immediately antecedent Clark Fork or earlier levels. It is this marked migrational movement that is taken to mark the most convenient position for the Paleocene-Eocene boundary, a line necessarily somewhat conventional and even arbitrary in a series that is essentially continuous.

?INSECTIVORA

Apheliscidae

Apheliscus nitidus, new species

TYPE.—Amer. Mus. No. 15849, maxillary fragment with left P⁴—M¹.

HORIZON AND LOCALITY.—Clark Fork, head of Big Sand Coulee, Wyoming.

DIAGNOSIS.—P⁴ with external and posterior cingula, basal contour of whole tooth more triangular than in *A. insidiosus*, M¹ with sharp anterior, external and posterior cingula, hypocone small but sharply differentiated. P⁴ length 2.6 mm., width 3.0. M¹ length 2.6, width 2.8.

Matthew (1918, p. 596) mentioned this specimen with the comment that it might represent a primitive mutant of *A. insidiosus*. As it is very readily distinguishable from the Gray Bull form, referred to the New Mexican "Wasatch" species, it seems best to give it a distinctive name and standing in the faunal lists. The type was figured by Matthew.

?Nyctitheriidae

For the purposes of future comparison, it may be recorded that Amer. Mus. No. 15850 is suggestive of *Nyctitherium* but certainly belongs to no described species and is probably of a new genus. It is inadequate as a type and is therefore not named or described.

TILLODONTIA

The section on tillodonts in the Matthew-Granger "Wasatch and Wind River" revision has not been completed or published and the Clark Fork (but not the Lower Eocene) tillodonts are therefore named and de-

scribed now. Dr. Granger has had this subject in hand for some time. He identified the specimens and directed the preparation of the illustrations of tillodonts here published (drawn by the late L. M. Sterling). Since, however, his administrative duties and the work of the Central Asiatic Expeditions have made it impossible for him to complete this study he has asked me to include it here. Dr. Granger insists that he be excluded from co-authorship of this paper or of this section of it and the results are in some details different from those of his preliminary study, but the fact that he did much of the work involved is gratefully acknowledged.

Esthonychidae

Esthonyx bisulcatus Cope, 1874

The nomenclature and taxonomy of *Esthonyx* are in a somewhat confused condition and cannot be entirely cleared up in this paper. The following species have been named:

E. bisulcatus Cope, 1874 (designated as genotype).

E. burmeisterii Cope, 1874.

E. acer Cope, 1874.

E. spatularius Cope, 1880.

E. acutidens Cope, 1881.

The first three types were from the "Wasatch" (Largo and Almagre) of New Mexico and the last from the Wind River Basin. In the original description *E. spatularius* was recorded as from the Wind River Basin, but in 1884 the same specimen, now Amer. Mus. No. 4809, was said to be from the Bighorn Basin. Cope's label gives the locality as "Bighorn B." On the other hand, Matthew concluded that Wind River Basin was correct or at least more probable, as shown by his labels and catalogue cards. In fact, it is possible to match the specimen almost exactly by others from the Gray Bull of the Bighorn Basin, and not so well with Wind River material. Together with the evidence that Cope's later statement was a correction, this seems to me to establish a strong probability that this is a Gray Bull species. The point is important because, if this conclusion is correct, this is the only species of *Esthonyx* based on a Gray Bull specimen and because some of the Clark Fork material is particularly close to this type.

E. burmeisterii and *E. acer* are probably synonyms of *E. bisulcatus*, or at least, the types do not seem to me to warrant specific distinction at present. *E. spatularius* is very doubtfully distinct, as will be shown. *E. acutidens* appears to be a good species characterizing later horizons.

Esthonyx is abundant in the Gray Bull. At least fifty individuals are

represented by lower jaws and teeth in our collections.¹ As is so often true in large collections, it would be easy to pick out two or three strongly distinctive types and define them as species, yet it is practically impossible to separate the whole collection into two or more clearly defined groups. The essential homogeneity is seen in data for the length of P_4 , which are corroborated by those for the other dimensions of P_4-M_3 , also calculated but not published here:

NUMBER	OBSERVED	MEAN	STANDARD DEVIATION	COEFFICIENT OF VARIATION
	RANGE			
20	7.1-8.7	7.90 ± 0.08	0.35 ± 0.06	4.5 ± 0.7

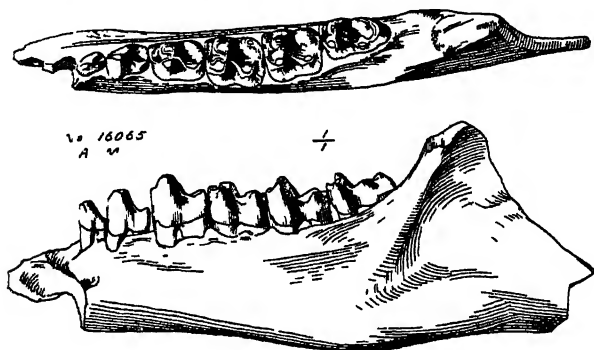


Fig. 1. *Esthonyx t. bisulcatus* Cope, 1874. Referred specimen from the Clark Fork. Amer. Mus. No. 16065, left lower jaw with P_2-M_3 . Crown and external views. Natural size.

The distribution, grouped, is as follows:

7.1-7.3 : 1
 7.4-7.6 : 4
 7.7-7.9 : 7
 8.0-8.2 : 5
 8.3-8.5 : 2
 8.6-8.8 : 1

The highest coefficient of variation is for length of M_3 and is 7.0 ± 1.0 .

There is certainly nothing in this to show or even to hint that more than one species is present. P_4 also shows the greatest morphological variation and here again the extremes are decidedly unlike but every intergradation occurs and there is no evident natural grouping.

At present there is little choice but to call all these varied Gray Bull

¹ Most of these are recorded only as Bighorn "Wasatch," but from locality records, faunal associations, etc., it is evident that nearly or quite all of them are from the Gray Bull.

specimens *Esthonyx bisulcatus*, since they are not themselves separable and include as variations all the characters of the New Mexican form. Typical *bisulcatus* is not at the mean for the Gray Bull material and perhaps a racial difference will later be established, but I cannot do this on present data.

The best tillodont in the Clark Fork collection is Amer. Mus. No. 16065, a left lower jaw with P_2 - M_3 . This differs markedly from the majority of the Gray Bull specimens. It is below their average size in all dimensions. P_2 is relatively small, P_3 relatively high and simple, and on P_4 the trigonid is more compressed anteroposteriorly and its two crests are more transverse than is usual in the Gray Bull. The same difference in the trigonids but in less degree is perceptible on M_1 - s and their metastylids are rather small. In all these respects, however, the whole Gray Bull series could include this specimen as a variant. Of course, no Gray Bull specimen is exactly like this, but various of the Lower Eocene forms bracket all the deviations of the Upper Paleocene specimen.

If it could be established that the Clark Fork specimen is near the mean for that horizon or that it is a variant toward the Gray Bull type, then a distinctive Clark Fork species or subspecies would be recognizable. There is some probability that this will prove to be true, but at present only this one Clark Fork specimen is available and a separation cannot be statistically and logically maintained.

The type of *E. spatularius*, consisting essentially of a single M_3 (also anterior teeth but the association is uncertain and adequate comparative material lacking), likewise falls within the range of variation for the Gray Bull *E. bisulcatus* group but near its lower limit. It follows that this type is particularly similar to the Clark Fork specimen and even if the latter were provisionally separated from *E. bisulcatus*, it would be quite impossible to distinguish it from *E. spatularius*. In view of the nature of the evidence, however, it is not established either that *E. spatularius* is a valid species or that the Clark Fork specimen is conspecific with its type. M_3 of *E. spatularius* measures 8.9 by 5.1 mm. The dimensions of Amer. Mus. No. 16065 are as follows:

P_2		P_3		P_4		M_1		M_2		M_3	
L	W	L	W	L	W	L	W	L	W	L	W
4.2	3.0	6.1	4.3	7.6	5.2	7.9	6.5	7.8	6.4	9.3	5.0

These are all within the known ranges of the Gray Bull material, except for the width of M_3 , which is 5.1 mm. in the smallest Gray Bull example.

The deviation from the Gray Bull mean is $-.68$, which is -2.2 times the standard deviation, not surely significant.

It may be noted that the Sand Coulee beds have yielded certainly three and possibly four species of *Esthonyx*. One is *E. grangeri* (see below) and one is indistinguishable from the Gray Bull *E. bisulcatus* group. There is also a very small form surely distinct from the Gray Bull group. Its length P_4 , for instance, deviates by -1.3 mm. from the Gray Bull

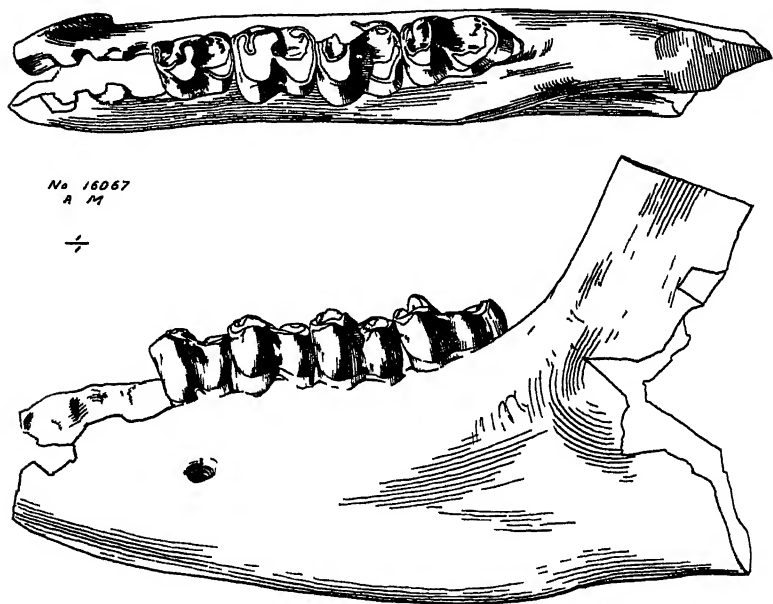


Fig. 2. *Esthonyx grangeri*, new species. Type, Amer. Mus. No. 16067, left lower jaw with P_4 - M_3 . Crown and external views. Natural size.

mean, which is -3.7 times the standard deviation of the latter and is surely significant, as are some other dimensions. It is entirely possible that the Clark Fork specimen here discussed is really a large variant of this Sand Coulee species, which may be *E. spatularius* or may (with more probability) be an unnamed species. This to some degree increases the probability that the Clark Fork specimen does not really belong to *E. bisulcatus* in spite of now being inseparable from the latter. It is further possible that *E. latidens* occurs in the Sand Coulee (see below).

Esthonyx grangeri,¹ new species

TYPE.—Amer. Mus. No. 16067, left lower jaw with P_4 - M_3 .

HORIZON AND LOCALITY.—Type either from top of Clark Fork or base of Sand Coulee beds, at head of Big Sand Coulee, Clark's Fork Basin, Wyoming. Referred specimens from undoubted Clark Fork and Sand Coulee horizons.

DIAGNOSIS.—Significantly larger than any other species of *Esthonyx* (measurements given below). Teeth and jaw in general within the structural range of Gray Bull referred *E. bisulcatus*, but very heavily built. P_4 comparable to Gray Bull variants with more advanced molarization.

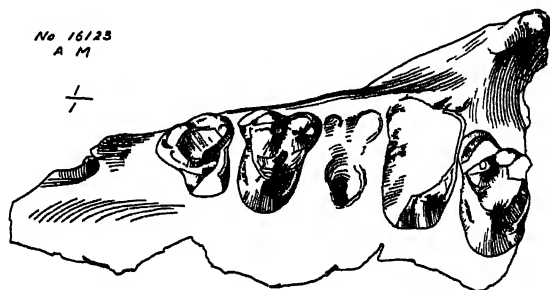


Fig. 3. *Esthonyx grangeri*, new species. Referred specimen, Amer. Mus. No. 16123, left upper jaw with P^3 - 4 , M^2 , and alveoli or roots. Crown view. Natural size.

The size of this large species is decisively distinctive from any other referred to the genus. For instance, comparing with the Gray Bull series the difference of this type from their mean divided by the corresponding standard deviation is +8.9 for length P_4 , +6.0 for length M_3 , and correspondingly great for all other dimensions. There seem to be no positive morphological distinctions from large and progressive Gray Bull variants aside from the generally heavier structure, both relatively and absolutely.

A referred specimen, Amer. Mus. No. 16123, from the type horizon and locality shows part of the upper dentition. P_4 has a large metacone, as in the more progressive Gray Bull specimens, but a very small hypocone. In the Gray Bull large metacone and large hypocone seem to be associated, so that this may prove to be a specific character.

The type and four referred specimens are from a horizon not positively

¹ Dr. Walter Granger. He had already given this species a different catalogue name, but as he has assigned its publication to me I take the opportunity of thus commemorating his collection of most of the known material and his first recognition of the species.

identified as it is near the indefinite Clark Fork-Sand Coulee boundary. There are, however, various specimens referable to this species with little or no doubt and known to be of both Clark Fork and Sand Coulee age, so that the species occurs in both those faunas. Its complete absence from the much larger Gray Bull collections may be one of the faunal differences between Sand Coulee and Gray Bull.

The dimensions of the type teeth are as follows:

P ₄		M ₁		M ₂		M ₃	
L	W	L	W	L	W	L	W
11.0	8.3	11.2	10.1	11.3	ca. 11	14.6	9.4

Esthonyx latidens,¹ new species

TYPE.—Amer. Mus. No. 16066, associated parts of juvenile dentition including left dm³-M¹, right dm⁴, left dm₃-M₁, and several anterior teeth.

HORIZON AND LOCALITY.—Type from Clark Fork beds, 3 miles east of mouth of Pat O'Hara Creek, Clark's Fork Basin, Wyo. Specimens referred (without certainty) from transitional Clark Fork-Sand Coulee.

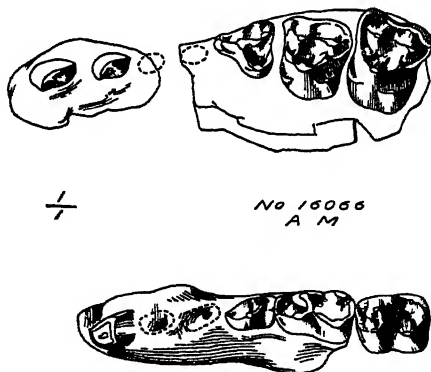


Fig. 4. *Esthonyx latidens*, new species. Type, Amer. Mus. No. 16066, left upper jaw with I²⁻³, dm³⁻⁴, and M¹, and left lower jaw with I₂ (broken), dm₃₋₄, and M₁. Crown views. Natural size.

DIAGNOSIS.—Intermediate in size between *E. grangeri* and Gray Bull referred *E. bisulcatus* and outside the known or probable range of either. Ratio of width to length in M¹ of type 1.22, smaller than in other species as far as known.

This form is definitely too large to belong with the Gray Bull *E. bisulcatus* group. It might conceivably be a small variant of *E. grangeri*, but the probability against this is strong enough to warrant definition of the present species. In four specimens of *E. grangeri* the length of M₁ is

¹ Name from labels (not manuscript) by Granger.

11-12, mean 11.4, while in the present type this is 10.3; moreover this type is unworn, hence has maximum length, while all the specimens of *E. grangeri* have the length reduced by wear. The true whole range for unworn teeth in the latter will in all likelihood be found to begin above 10.5, at least, and probably higher. M_1 is unknown in *E. grangeri*, but in Amer. Mus. No. 16123 the alveoli and adjacent teeth are preserved, evidently with no distortion. They indicate a transverse and *bisulcatus*-like tooth, probably, indeed, even more transverse than the Gray Bull average. The width: length ratio cannot have been much less than 1.45, and perhaps was greater. In seven specimens from the Gray Bull the range is 1.35 - 1.45, mean 1.39. *E. latidens*, with this ratio 1.22, is significantly different.

CREODONTA

Arctocyoniidae

Thryptacodon antiquus Matthew, 1915

In the Sand Coulee and Gray Bull there are perhaps two subspecies of *Thryptacodon antiquus*, as the eleven measurable specimens of our collection fall into two groups, one smaller in size with four individuals and one larger with seven individuals. Two of the smaller individuals are labeled as from the Sand Coulee, the other two only as Wasatch. The type, belonging to the larger group, is from the Gray Bull, the other six larger specimens labeled only "Wasatch" but apparently from Gray Bull localities. It is thus possible, but the data cannot prove, that a smaller subspecies occurs in the Sand Coulee and a larger in the Gray Bull.

The range of the length of M_2 of the six larger specimens is 6.7 - 7.1 and the mean 6.9 (type 6.8). The range of the four smaller specimens is 5.9 - 6.3 and the mean 6.1. The two Clark Fork specimens, all that are available, measure 7.0 and 7.2 in this dimension. They are thus comparable with the larger specimens of the larger "Wasatch" group. On the basis of these small samples the difference is not shown to be significant (would be exceeded by mere chance in collecting one or two times out of ten).

The length-width M_2 ratio of the larger "Wasatch" specimens has the range 1.15 - 1.35 and mean 1.24. That of the smaller specimens has range 1.20 - 1.27, mean 1.23. The two Clark Fork specimens have the ratios 1.17 and 1.22. While they are thus slightly below the average for the later specimens, they are within the range of the latter and are so near that mean that the chances of such a difference being due to mere chance of sampling are better than even.

The "protostyle on M_2 " of which Matthew speaks is a small basal cuspule between the protoconid and hypoconid. It is present on one Clark Fork specimen, absent on the other. It is present, but weak, on two of the seven larger "Wasatch" specimens. No valid difference between Clark Fork and later specimens is demonstrated by these data. This cusp, incidentally, is extremely variable both in arctocyonids and in phenacodonts. On two specimens almost certainly of exactly the same race one may have it very large and prominent and the other lack it entirely.

Matthew's conclusion (1915A, p. 8) that the Clark Fork specimens probably represent a new species or subspecies characterized by broader teeth (smaller length-width ratio of M_2) and distinct protostyle on M_2 is thus not supported by the available material. Larger samples might demonstrate mean differences of subspecific value, but the specimens in hand do not do so.

It is interesting to note the possibility, not proven in this case but very suggestive of the condition in *Didymictis* and in *Haplomylus* (see below) that the Clark Fork representatives of this species are as large and generally advanced as the most progressive Gray Bull specimens and more so than those of the intervening Sand Coulee, a condition to be interpreted only as indicative of migrational and facies changes.

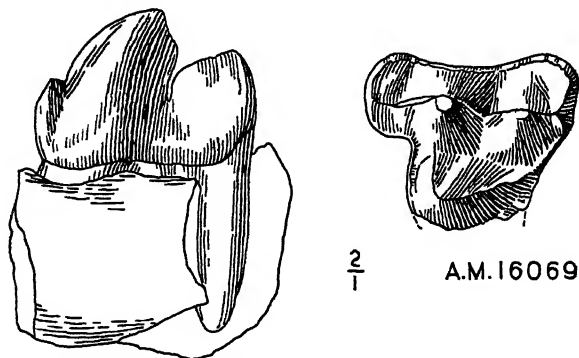


Fig. 5. *Dissacus praeununtius* Matthew, 1915. Type, Amer. Mus. No. 16069, left P_4 , external view, and left M^1 . Crown view. Twice natural size.

Mesonychidae

Dissacus praeununtius Matthew, 1915

This species was adequately characterized, but not figured, by Matthew. It is here figured.

Oxyaenidae

All three known Clark Fork oxyaenid species are confined to that horizon, although *Oxyaena aequidens* and *Dipsalidictis platypus* have successors in the Lower Eocene. Matthew (1915A, p. 47) mentioned and briefly described a Clark Fork specimen which he considered as representing a new species possibly of *Oxyaena*. Comparable parts are too limited for decision, but it seems possible that this is the form later named *Dipsalodon matthewi* by Jepsen. Matthew's specimen is, in any event, scarcely determinable in itself. There are also some other oxyaenid scraps evidently not *O. aequidens*, but too imperfect for determination.

Ambloctonus priscus does not belong in the Clark Fork fauna. Matthew (1915A, p. 60) states that the paratypes Amer. Mus. Nos. 16116 and 16117 are from this horizon, but this was apparently a *lapsus calami*. The field records give "Intermediate Beds" as the horizon, a field designation for the Sand Coulee, before the latter name was given, and the labels, in Matthew's hand, give "Sand Coulee." The locality is given as "2 miles S.-E. of m'th of Pat O'Hara Cr'k." There are many Sand Coulee specimens, including *Hyracotherium*, with these locality data, but no Clark Fork specimens, although several of the latter are labeled as from east, or three miles east (but not southeast) of the mouth of Pat O'Hara Creek. There can be no doubt that the specimens are from the Sand Coulee, not the Clark Fork.

Miacidae

Didymictis protenus proteus, new subspecies

TYPE.—Amer. Mus. No. 16071, parts of lower jaw with right P_4 (broken), left M_1 (broken), and right M_2 .

HORIZON AND LOCALITY.—Clark Fork Beds, head of Big Sand Coulee, Clark's Fork Basin, Wyoming.

DIAGNOSIS.—Characteristic *D. protenus*, dimensions intergrading with those of Gray Bull and Almagre specimens, but differentiated by the dimensions of M_2 , mean length 8.2, mean width 4.6, mean length-width ratio 1.8. See data below.

Matthew (1915A) considered the more common *Didymictis* of the Clark Fork and Lower Eocene as showing a series of progressive mutants distributed as follows:

Didymictis protenus leptomylus (Cope, 1880)—Clark Fork to Lower Gray Bull.

Didymictis protenus protenus (Cope, 1874)—Middle and Upper Gray Bull.

Didymictis protenus lysitensis (Matthew, 1915)—Upper Gray Bull and Lysite.

Didymictis altidens (Cope, 1880)—Lost Cabin.

These were supposed to be progressive, in the order given, in size and, less explicitly, some other characters.

An adequate revision is beyond the scope of these notes (and is hardly

possible), but the series has been carefully examined for its bearing on the Clark Fork specimens and the use of other methods of study suggests that Matthew's conclusions may be in part ill founded and in part erroneous.

The Wyoming "Wasatch" forms, for the most part Gray Bull and possibly including some from the Sand Coulee although none is explicitly so recorded, show considerable variation in dimensions even among those referred with high probability to *D. protenus*. The four coefficients of variation given below, 5.0, 5.2, 7.1, and 8.4, are, in conjunction, high

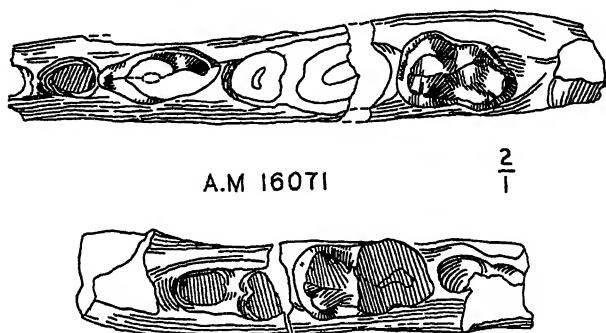


Fig. 6. *Didymictis protenus proteus*, new subspecies. Type, Amer. Mus. No. 16071, right lower jaw with P₄ and M₂, and associated left lower jaw with broken M₁. Crown views. Twice natural size.

enough to include more than one pure local race, but not so much so as to warrant, without other data, the assumption that more than one race is in fact present. As a considerable span of time is represented, it is reasonable to suppose that progressive changes did take place and that the range of variation is due in part to such changes, and not purely to contemporaneous fluctuation. No basis for separation exists in the characters of M₂, the commonest and in many respects most characteristic tooth in the collections. M₁, however, could separate the Gray Bull *D. protenus* into three groups, but there is no statistical probability that such separation is valid, it cannot be shown to be associated with differences in age, and it does not even approximately correspond with Matthew's three-fold separation into *leptomylus*, *protenus*, and *lysitensis*. It is probable that a two- or three-fold subspecific division of Gray Bull (and Sand Coulee) *Didymictis protenus* would be warranted with more accurate data, but this is necessarily deferred.

D. protenus lysitensis is about intermediate between the general Gray Bull groups and *D. altidens*, but in several respects it falls rather within

the *D. altidens* group, as a variant, than within that of the Gray Bull specimens. Thus its length M_1 in the type is almost exactly at the mean for the general *altidens* group but distant nearly four times the standard deviation from the mean for the Gray Bull specimens. If it is not a synonym of *D. altidens*, it seems a much better representation of its character to make this a subspecies of *altidens*, as *Didymictis altidens lysitensis* (Matthew), rather than of *protenus*. No specimen probably referable to the *altidens* group is known from the Gray Bull, or labeled "Wasatch" in the old collections, nor does any occur in the Clark Fork.

D. leptomylyus Cope was described as from the "Wind River," but certainly is very distinct from the *altidens-lysitensis* group and may be from the Gray Bull. Matthew believed it to be applicable to a small subspecies of Clark Fork and Gray Bull *D. protenus*. On the revaluated data, the type of *D. leptomylyus* seems on the contrary to be either a highly abnormal individual or the sole representative of a distinct species (of unknown exact horizon). It has far the smallest M_1 of any specimen in the collection (deviation from the mean for the Gray Bull group about three times the standard deviation). Its M_2 is almost at the mean for the Gray Bull, or *protenus*, group in length, but is narrow (deviation 2.3 times standard deviation), giving it a high length-width ratio (deviation 3.3 times standard deviation in comparison with *protenus* group). It is extremely improbable that any of the Gray Bull specimens referred by Cope or Matthew to *leptomylyus* belong there, and for any practical purpose it is certain that Matthew's referred Clark Fork specimens do not.

The type of *protenus* is from the New Mexican "Wasatch." In all its dimensions it falls within the range of variation of the Gray Bull specimens, but it is decidedly marginal in several respects, short M_1 , long M_2 , high length-width ratio of M_2 . The combination is peculiar, and it is improbable that the Gray Bull forms are in fact, identical with *D. protenus*, but distinction is not positively demonstrable. They should probably be referred to one or more distinct subspecies, which might acquire specific rank with increased knowledge of topotypic *protenus*, for which (or for the larger subdivision of which) the name *curtidens* is available, *D. curtidens* Cope being based on a fairly typical, but poorly preserved, Gray Bull specimen. If there are two subspecies (or other groups) in the Gray Bull, *curtidens* applies to the larger animals.

The Clark Fork specimens are within the range of those from the Gray Bull in every dimension, but they nevertheless are significantly different as a group, and they do not, as Matthew thought, compare with the smaller Gray Bull forms. M_1 (a single specimen) does not differ significantly

from the Gray Bull mean, its deviation being only 0.5 times the standard deviation. M_2 , however, is significantly longer than the mean of the Gray Bull specimens. Here five individuals are available, and Fisher's¹ more exact test for the significance of the deviation of the means of two small samples can be applied. By this method, for length M_2 P (see Fisher) is less than 0.01, for width M_2 it is greater than 0.1 and for the length-width ratio it is between 0.05 and 0.02. In other words it is extremely likely (for all practical purposes certain) that the greater length of M_1 in the Clark Fork specimens is due to a real difference in the animals of that time and not merely due to the chance that larger specimens happen to have been found in that level, the slightly greater width of M_2 may very well be due to chance, and the greater length-width ratio is probably not, but might be, due to chance (chances less than one in twenty). The group is thus different and this may be signalized by making it a subspecies of the general *protenus* group.

It may be noted that the Clark Fork to Lost Cabin specimens do not form a single linear sequence. Several lines are present, and some migration or change of facies, possibly of a local nature, is indicated between the Clark Fork and Gray Bull, the differences not being explicable with any probability as due to evolution *in situ*.

Some of the available data are given below. The Lysite and Lost Cabin specimens have also been measured and their constants calculated, but they are not pertinent to the present discussion.

Clark Fork *Didymictis*, *D. protenus protenus*:

VARIATE	NUMBER	OBSERVED		STANDARD DEVIATION	COEFFICIENT OF VARIATION
		RANGE	MEAN		
Length M_2	5	8.0-8.3	8.2 ± 0.1	0.12 ± 0.04	1.4 ± 0.5
Width M_2	5	4.4-5.0	4.6 ± 0.1	0.21 ± 0.07	4.6 ± 1.5
$\frac{\text{Length}}{\text{Width}} M_2$	5	1.7-1.9	1.8 ± 0.0	0.08 ± 0.02	4.4 ± 1.4

Sand Coulee and Gray Bull *Didymictis*, *D. protenus curticens* and possibly another closely related subspecies:

VARIATE	NUMBER	OBSERVED		STANDARD DEVIATION	COEFFICIENT OF VARIATION
		RANGE	MEAN		
Length M_2	26	6.7-8.3	7.5 ± 0.1	0.39 ± 0.05	5.2 ± 0.7
Width M_2	26	3.7-5.1	4.4 ± 0.1	0.31 ± 0.04	7.1 ± 1.0
$\frac{\text{Length}}{\text{Width}} M_2$	26	1.5-1.9	1.7 ± 0.0	0.09 ± 0.01	5.0 ± 0.7
Length M_1	16	10.0-13.0	11.1 ± 0.2	0.93 ± 0.17	4.8 ± 1.5

¹ The t test, given in Fisher's manual cited in a previous footnote.

CONDYLARTHRA

Phenacodontidae

Phenacodus primaevus

Granger (1915) made a four-fold division of the larger Gray Bull *Phenacodus*, as follows:

Phenacodus primaevus robustus
Phenacodus primaevus primaevus
Phenacodus primaevus hemiconus
Phenacodus intermedius

It is probable that this division is valid, at least in a general way. Upon consideration of the whole series, however, the demarcation proves to be difficult or impossible in some cases. *P. p. robustus* is represented by a small number of specimens rather closely clustered about their mean. They are not far removed from the next smaller specimens, large variants of *P. p. primaevus*, but in our material, at least, there is a discontinuity, the two groups can be distinguished almost at a glance, and there is no specimen of doubtful position between them. It may be taken that *robustus* is surely valid and it is so much more distinct than are the other three groups that I believe that it should be raised to full specific rank, as *Phenacodus robustus* (Granger, 1915).

Omitting this large species, the other specimens of this group form an essentially continuous distribution. In individual measurements, the distribution tends, indeed, to have two or three modes. The length of M_3 , for instance, suggests modes at or near 10.7, 12.3 or 12.4, and 14.0, which may correspond with *P. intermedius*, *P. p. hemiconus*, and *P. p. primaevus*, respectively. But even in cases of single dimensions this polymodality is not sufficiently pronounced to be statistically significant, and when the whole character of each specimen is considered it disappears altogether. That is, the segregation vaguely suggested by a single character is not positively correlated with groupings suggested by other characters and the whole series takes on the appearance of an indivisible but highly variable and very flat (in statistical terms platykurtic) distribution.

It is highly unlikely that such a distribution belongs to a single pure race. It could, and probably does, represent sampling from several, perhaps three, closely related races or subspecies, but the only hope of making a separation of any really probable validity would be to obtain several fairly large samples of completely unified origin, each from a single hori-

zon and locality. Such samples are not now at hand and the present situation is that the subspecies cannot be distinguished in any natural way.

It does not follow that they are synonymous, for the fact that they cannot be fully distinguished does not prove that they are the same thing. They may also be convenient conventional designations for the smaller, medium, and larger specimens, respectively, which are felt probably to represent different races even though this cannot be proved. *P. intermedius* is, however, so intimately connected with the others that its status as a separate species can hardly be maintained and if distinguished, it should be referred to as *P. primaevus intermedius*. (Note that it is the smallest, not medium-sized, group in this species.)

A first approach toward an adequate sample is afforded by the Clark Fork phenacodonts. Their origin is not fully unified but their distribution, both geographically and stratigraphically, is much more limited than for the Gray Bull specimens. There are twenty-five specimens in our collection. One of these may be omitted as it consists of scraps of doubtful association some of which are highly aberrant or abnormal. Another specimen is so distinct from the rest (which are rather unified among themselves) that the probability is very great that it is a stray of a different race. Some of the statistical constants for the remaining twenty-three specimens are as follows:

VARIATE	NUMBER	OBSERVED RANGE	MEAN	STANDARD DEVIATION	COEFFICIENT OF VARIATION
L M ₁	8	12.2-13.6	12.9 ± 0.2	0.46 ± 0.12	3.6 ± 0.9
W M ₁	7	9.8-11.8	10.8 ± 0.3	0.69 ± 0.18	6.4 ± 1.7
L M ₂	11	12.2-14.4	13.3 ± 0.2	0.60 ± 0.13	4.5 ± 1.0
W M ₂	10	10.4-12.2	11.4 ± 0.2	0.58 ± 0.13	5.1 ± 1.1
L M ₃	14	12.2-15.0	13.1 ± 0.2	0.77 ± 0.15	5.9 ± 1.1
W M ₃	13	9.2-10.6	9.8 ± 0.1	0.47 ± 0.09	4.8 ± 0.9

For comparison, the constants of one dimension, length of M₂, for the Gray Bull *intermedius* - *hemiconus* - *primaevus* group are given.

L M ₂	61	10.6-13.8	12.1 ± 0.2	0.96 ± 0.09	7.9 ± 0.7
------------------	----	-----------	------------	-------------	-----------

And the same for *P. robustus*:

L M ₂	6	14.4-14.8	14.6 ± 0.1	0.14 ± 0.04	0.9 ± 0.3
------------------	---	-----------	------------	-------------	-----------

This is, on our specimens, the least variable dimension of *P. robustus* but none of its dimension distributions overlaps those of the *primaevus* group and none shows a significantly closer approach to the Clark Fork group.

The difference between the Clark Fork *Phenacodus* and Gray Bull *P. robustus* is certainly significant. The difference between the Clark Fork group and the whole Gray Bull *P. primaevus* group is also certainly significant, that is to say, it would be impossible (for all practical purposes) to take a random sample of eleven specimens of M_2 from the Gray Bull *P. primaevus* and have the mean of their length as large as that for the Clark Fork (and the same is true of the other dimensions). However, it has already been concluded that the Gray Bull specimens probably include several subspecies, and if this is true the largest of these may not be significantly different from the Clark Fork specimens.

The biological conclusion is that the Clark Fork specimens are a nearly or quite homogeneous sample of one subspecies and that this subspecies may occur also in the Gray Bull (in which case it is probably *P. primaevus primaevus*) or may be distinct. These alternatives cannot at present be adequately checked. It seems somewhat more probable that the subspecies is distinct. In any event reference to the species *P. primaevus* is justified.

The aberrant Clark Fork specimen which probably is not of the common subspecies mentioned above is Amer. Mus. No. 16053 and has these dimensions:

M_1		M_2		M_3	
L	W	L	W	L	W
11.0	...	10.8	9.8	11.2	8.7

All these dimensions are distant between two and three times the standard deviation from the mean of the other specimens. This could belong to the smallest Gray Bull subspecies (*P. p. intermedius*), if that is distinct, might (but very improbably) be a variant of the common Clark Fork form, or might be separable from either. It may be listed as *Phenacodus primaevus*, small var. cf. *intermedius*.

Ectocion osbornianus ralstonensis (Granger, 1915)

Granger (1915) recognized four species of *Ectocion*, as follows in order of size:

- E. parvus*
- E. ralstonensis*
- E. osbornianus*
- E. superstes*

E. parvus is based on a single specimen from the Clark Fork. The next two species were reported from Clark Fork, Sand Coulee, and Gray Bull, with the note that the smaller form is more abundant in the older

beds. *E. superstes* is from the Lost Cabin, with two specimens doubtfully referred from the Gray Bull.

Detailed statistical study of the whole collection fully confirms the general sequence as pointed out by Granger, but suggests a slightly different formalization and interpretation.

E. parvus is rather distinctive. It is either a highly aberrant individual or a straggler of another species, and, while it is naturally dubious as long as only one specimen is known, it may be retained as a species, and disregarded so far as study of the more common and typical animals is concerned.

The following grouped distribution is typical of that for all the available variates of *Ectocion* not referable to *E. parvus*:

LENGTH OF M_1	CLARK FORK	SAND COULEE	GRAY BULL	ALL
5.7-6.0	1	0	0	1
6.1-6.4	6	3	1	10
6.5-6.8	4	4	7	15
6.9-7.2	1	3	2	6
7.3-7.6	0	0	2	2

The number of specimens being rather small, some of the other variates are not so evenly distributed, but none shows deflections that are significant. Neither in any single formation nor in all taken together is there any probable indication that the population is not homogeneous. It is highly probable that only one species is represented and that the specimens called *E. ralstonensis* are simply the smaller and those called *E. osbornianus* the larger specimens of the same species. There is, however, an interesting difference between the samples from successive horizons.

All the data give about the same result. As an example the constants for the length of M_1 are given:

HORIZON	NUMBER OF OBSERVED		MEAN	STANDARD DEVIATION	COEFFICIENT OF VARIATION
	SPECIMENS	RANGE			
Clark Fork	12	5.9-7.1	6.5 ± 0.1	0.32 ± 0.06	4.9 ± 1.0
Sand Coulee	10	6.2-7.2	6.7 ± 0.1	0.33 ± 0.07	5.0 ± 1.1
Gray Bull	12	6.4-7.4	6.8 ± 0.1	0.39 ± 0.08	5.7 ± 1.2

The ranges overlap extensively, but with the passage of time there is a slow increase in the value of the mean. Between successive horizons,

Clark Fork and Sand Coulee or Sand Coulee and Gray Bull, the change is not statistically significant¹—the possibility of its arising from random sampling of a homogeneous population is too great to rely on the difference in itself as real. But between the earliest and the latest populations it is probably significant.

Since the sample from the intermediate horizon is also intermediate in all the means of its variates this association makes it practically certain that the difference here is likewise significant.

Granger clearly brought out this difference when he mentioned the greater abundance of smaller animals in the older beds. It appears extremely probable, however, that instead of there being two species that run through three horizons, the larger slowly increasing and the smaller decreasing in numbers, there is a single species, variable in all horizons but slowly increasing in size with the passage of time. The Lost Cabin *E. superstes*, which is still larger and considerably later, is perhaps the continuation, and end, of the same sequence.

The expression of this relationship in Linnaean taxonomy is necessarily conventional and a matter of personal preference. It is, perhaps, most satisfactory to use the name *E. osbornianus* for the whole phylum and to apply the name *ralstonensis*, as a subspecies, not to the smaller individuals of all horizons, surely an unnatural arrangement, but to the whole ancestral and on the average smaller (and also slightly more primitive in some morphological respects) group from the Clark Fork. This is conventional, as any system that draws boundaries in a continuous series must be, but it is logical and is natural in the sense of grouping together all the various animals that constituted the species at a given time.

This concrete example which seems open to little doubt, suggests that many of the supposed cases of the parallel development, or orthogenetic evolution, of closely allied phyla through several geological horizons may be misinterpretations of conditions similar to these: that in fact only one variable phylum is present and that the several supposed phyla are constructed by selecting variants in the same direction from each horizon and supposing them to form separate series (see Simpson, 1937).

The principal statistical constants of *E. osbornianus ralstonensis* that can be calculated from our material are as follows:

¹ Tested by Fisher's formula for comparing means of small samples, cited above. Between Clark Fork and Sand Coulee the value of *P* is between 0.1 and 0.05, for the variate given above. Between Clark Fork and Gray Bull it is less than 0.05.

VARIATE	NUMBER	OBSERVED RANGE	MEAN	STANDARD DEVIATION	COEFFICIENT OF VARIATION
	OF SPECIMENS				
L P ₄	13	6.3-7.2	6.7 \pm 0.1	0.23 \pm 0.04	3.4 \pm 0.7
W P ₄	13	4.2-5.8	4.9 \pm 0.1	0.36 \pm 0.07	7.3 \pm 1.4
L M ₁	12	5.9-7.1	6.5 \pm 0.1	0.32 \pm 0.06	4.9 \pm 1.0
W M ₁	12	4.9-5.7	5.4 \pm 0.1	0.24 \pm 0.05	4.5 \pm 0.9
L M ₂	12	6.1-7.2	6.7 \pm 0.1	0.38 \pm 0.08	5.3 \pm 1.1
W M ₂	12	5.1-6.1	5.6 \pm 0.1	0.31 \pm 0.06	5.5 \pm 1.1
L M ₃	11	7.1-8.2	7.6 \pm 0.1	0.39 \pm 0.08	5.2 \pm 1.1
W M ₃	11	4.6-5.5	5.1 \pm 0.1	0.27 \pm 0.06	5.3 \pm 1.1

Hyopsodontidae

Haplomylus speirianus (Cope, 1880)

This species is abundant in the Gray Bull, uncommon in the Sand Coulee, and rare in the Clark Fork, from which only three specimens are known. I have measured all the sufficiently well-preserved lower jaws in the American Museum collections (forty in all) and have calculated the statistical constants of the most abundant group, those from the Gray Bull. An interesting relationship appears. The Sand Coulee specimens, although their range overlaps (but is not entirely included in) that of the Gray Bull specimens, average smaller, and the difference in size is decisively significant (the chances that such a difference would be due to random sampling of the same race are considerably less than one in a hundred). The three Clark Fork specimens, however, more closely resemble those from the Gray Bull, and not those from the Sand Coulee as one would expect from their ages. They are relatively large, even for the Gray Bull series, but could be three random specimens drawn from the same subspecies or race as that occurring in the Gray Bull. They cannot be exactly the same race as that in the Sand Coulee.

As they bear only indirectly on the characters of the Clark Fork forms, the full data for the Sand Coulee and Gray Bull are not here published, but one variate is given, and the measurements of the Clark Fork specimens:

Length of M₂ in Gray Bull *Haplomylus speirianus*:

NUMBER	OBSERVED RANGE	MEAN	STANDARD DEVIATION	COEFFICIENT OF VARIATION
23	2.5-3.1	2.79 \pm 0.04	0.19 \pm 0.03	6.7 \pm 1.0

Clark Fork specimens:

	P ₄		M ₁		M ₂		M ₃	
	L	W	L	W	L	W	L	W
16074	3.4	1.8	2.9	2.4	...	..	.	.
16072	...	..	..	..	3.0	2.6	2.9	1.9
.....	...	...	3.1	2.7	3.0	2.8	..	.

These measurements are all large in comparison with the Gray Bull specimens, lying at or near the observed upper limit for the latter. In the small sample available, they fall just short of statistical significance.¹ If several more Clark Fork specimens were found and these were also large, the probability of a real difference would be sufficiently great to warrant separating these early individuals as a large race or subspecies, but of course this possible or probable future discovery cannot be anticipated.

PANTODONTA

Coryphodontidae

Coryphodon sp.

The principal evidence of *Coryphodon* in the fauna is a single specimen, No. 16078, which includes P₃ - M₃, P₂-4, and an upper molar. The teeth are very badly preserved and no specific determination is possible.² They do, however, demonstrate that the genus is *Coryphodon* and not *Titanoides* or *Barylambda*.

REFERENCES

- GRANGER, W. 1914. 'On the names of Lower Eocene faunal horizons of Wyoming and New Mexico.' Bull. Amer. Mus. Nat. Hist., XXXIII, pp. 201-207.
1915. 'A revision of the Lower Eocene Wasatch and Wind River faunas. Part III.—Order Condylarthra. Families Phenacodontidae and Meniscotheriidae.' Bull. Amer. Mus. Nat. Hist., XXXIV, pp. 329-361.
- JEPSEN, G. L. 1930A. 'Stratigraphy and paleontology of the Paleocene of north-eastern Park County, Wyoming.' Proc. Amer. Phil. Soc., LXIX, pp. 463-528.
- 1930B. 'New vertebrate fossils from the Lower Eocene of the Bighorn Basin, Wyoming.' Proc. Amer. Phil. Soc., LXIX, pp. 117-131.
- MATTHEW, W. D. 1915A. 'A revision of the Lower Eocene Wasatch and Wind

¹ By Fisher's t test the dimensions of M₁-₃ give P in the neighborhood of 0.1 or (length M₁) less, but all greater than 0.05. Individual deviations from Gray Bull means are up to 1.9 times (for the length of P₄) the standard deviation of the latter. Taken together, and with their association with age, the differences on these data are possibly significant, but with probability not quite great enough to be accepted as reliable.

² The genus is furthermore in need of revision and the true characters of its species are not understood.

- River faunas. Part I.—Order Ferae (Carnivora). Suborder Creodonta.' Bull. Amer. Mus. Nat. Hist., XXXIV, pp. 4–103.
- 1915B. 'A revision of the Lower Eocene Wasatch and Wind River faunas. Part II.—Order Condylarthra, Family Hyopsodontidae.' Bull. Amer. Mus. Nat. Hist., XXXIV, pp. 311–328.
- 1915C. 'A revision of the Lower Eocene Wasatch and Wind River faunas. Part IV.—Entelonychia, Primates, Insectivora (part).' Bull. Amer. Mus. Nat. Hist., XXXIV, pp. 429–483.
1918. 'A revision of the Lower Eocene Wasatch and Wind River faunas. Part V.—Insectivora (continued), Glires, Edentata.' Bull. Amer. Mus. Nat. Hist., XXXVIII, pp. 565–657.
- MATTHEW, W. D., AND W. GRANGER. 1915. 'A revision of the Lower Eocene Wasatch and Wind River faunas. Introduction.' Bull. Amer. Mus. Nat. Hist., XXXIV, pp. 1–4.
- SIMPSON, G. G. 1929. 'A new Paleocene uintathere and molar evolution in the Amblypoda.' Amer. Mus. Novitates, No. 387, pp. 1–9.
1937. 'Patterns of phyletic evolution.' Bull. Geol. Sc. Amer., XLVIII, pp. 303–314. [Interpretation of such sequences as that of *Ectocion* described in the present paper.]
- SINCLAIR, W. J., AND W. GRANGER. 1912. 'Notes on the Tertiary deposits of the Bighorn Basin.' Bull. Amer. Mus. Nat. Hist., XXXI, pp. 57–67. [First mention of Clark Fork fauna, tentatively named "Ralston".]

AMERICAN MUSEUM NOVITATES

Number 955

Published by
THE AMERICAN MUSEUM OF NATURAL HISTORY
New York City

October 30, 1937

THE SKELETON OF STYRACOSAURUS WITH THE DESCRIPTION OF A NEW SPECIES

By BARNUM BROWN AND ERICH M. SCHLAIKJER

INTRODUCTION

One of the dinosaur skeletons collected in the summer of 1915 from the Belly River formation by an American Museum Expedition under the leadership of the senior writer, in the Red Deer River country, Alberta, Canada, has recently been prepared and mounted for exhibition. This specimen was identified in the field as *Monoclonius* because of the extraordinary similarity to that genus as seen in the exposed parts when the skeleton was collected. Last summer when the blocks of matrix containing this ceratopsian were opened in the laboratory and preparation began, it was discovered that the specimen was an unusually perfect skeleton of *Styracosaurus*. Subsequent preparation has shown that it represents a new species, a description and study of which is given in the following pages.¹

DESCRIPTION AND COMPARATIVE STUDY

CERATOPSIA

Ceratopsidae

Styracosaurus parksi,² new species

TYPE.—Amer. Mus. No. 5372, nearly complete skeleton with parts of the skull and left lower jaw. Collected by Barnum Brown, 1915.

HORIZON AND LOCALITY.—Belly River formation, Upper Cretaceous. Middle Fork of Sand Creek on the right bank, approximately 250 feet above the Red Deer River, 12 miles below Steepleville, Alberta, Canada.

DIAGNOSIS.—Squamosal long and broad. Possesses three large, blunt, and flattened projections on its postero-external margin. Posterior end of central bar of frill massive and rounded. Anterior lateral bar of frill with large, oval, epoccipital base near its union with the squamosal. Lateral temporal fossa small. Jugal broad and deep.

The genus *Styracosaurus* was described by Lambe in 1913. The genoholotype consists of a fine, although somewhat crushed, skull that lacks the rostral bone and the lower jaws. This specimen was collected

¹ As a matter of record, it should be noted that the type of the earliest known marsupial, *Didelphis browni* Amer. Mus. No. 14189, described by Matthew (1916, pp. 482-491) was found under the pelvis of this skeleton.

² Named for the late Dr. W. A. Parks.



Fig. 1. Collecting of *Styracosaurus parksi*, new species, from the typical variegated sandstone, sands, and clay of the Belly River formation. Right bank of Middle Fork of Sand Creek, approximately 250 feet above the Red Deer River, 12 miles below Steeveville, Alberta, Canada.

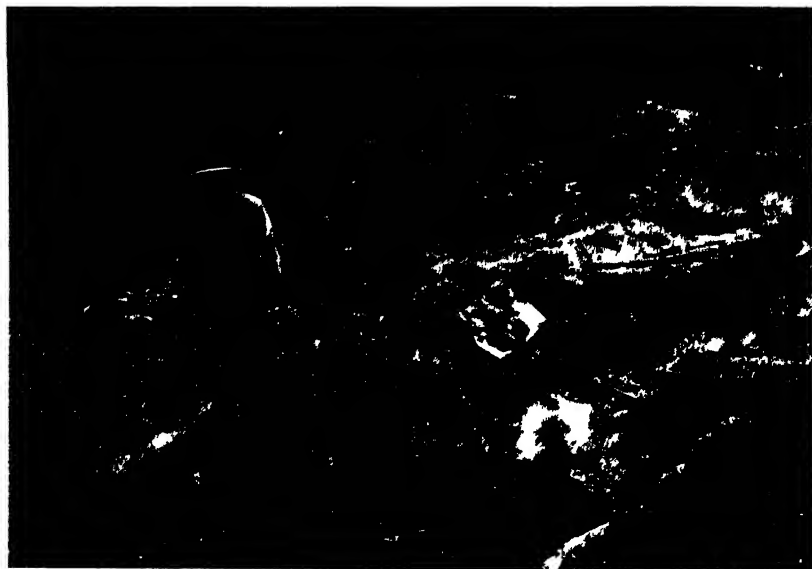


Fig. 2. Same as shown in Fig. 1. Mr. A. H. Johnson standing by the partially collected skeleton of *Styracosaurus parksi*, new species.

from the Belly River formation on the Red Deer River, Alberta, Canada, during the summer of 1913 by Mr. Charles M. Sternberg. In 1935 an expedition from the University of Toronto visited the site of the discovery and found, through further excavation nearby, the jaws and a goodly portion of the skeleton of the same individual disarticulated and scattered over a considerable area. Through the courtesy of the Toronto Museum and the late Dr. W. A. Parks, some of this material has been loaned to us for comparison and has been useful as a guide in restoring certain parts of the American Museum specimen.

While our specimen comes from the same formation and from the same general locality as the type, there is no question of its being specifically distinct. With the exception of the quite fragmentary skull, and the absence of most of the first three coössified cervicals, and the distal end of the tail, the specimen is unusually complete. Most of the desired information about what is perhaps the most unusual of all the ceratopsians is revealed in this fine skeleton which is now fully prepared and placed on exhibition. A discussion of its more salient features is included in the following.

The skull was almost completely exposed but the squamosal, quadrate, quadratojugal, jugal, posterior portion of the maxillary, and lower jaw of the left side were undisturbed and uncrushed. The rest of the skull was eroded away, although many of the fragments were recovered from down the hillside. Most of these broken fragments have been pieced together and have been identified as to position, but many cannot be placed accurately in the restored skull.

A considerable amount of the inferior left and outer right sides of the rostral is preserved. Only the front tips of the nasals, which are in contact with the rostral, are present, but parts of the nasal horn show that it was large and of the usual oval form. The postorbital presents a rather large and roughened dorsal knoblike elevation, which shows that it probably was capped by some sort of epidermal padlike development. The orbital border of the postorbital and the orbital border preserved on a fragment of the lacrymal and on the jugal indicate that the orbit was large and round in form. The jugal is broad proximally, deep, and pointed distally. In these features it is quite distinct from that of *S. albertensis*, which is rather narrow and is quite uniform in width throughout much of its distal region—a general form that is more like the jugal of *Triceratops*. The epijugal is small and is somewhat pyramidal in general form.

The squamosal, when compared with that of *S. albertensis*, is dis-

tinctly longer, and is sub-quadrangular in outline. In *S. albertensis* it is broader than long and is markedly pointed posteriorly. Likewise, the external border in the Ottawa specimen presents five convexities while in *S. parksi* there are three large, blunt, dorso-ventrally compressed projections. The anterior of these is the smallest, the posterior one the largest.

Of the middle frill element, only the posterior bases of projections I, III, and IV, and the antero-lateral extensions on the left side are preserved. From these it is possible to ascertain the diameters of the projections. The posterior end of the central bar is massive and rounded; just mesially to the base of process I there is an incompletely preserved anterior process that probably extended only a short distance over the frill fenestra. This projection is not present on the frill of *S. albertensis*. Also, process IV in *S. parksi* is larger and straighter. Anterior to it there is a large, oval, epoccipital base near the union with the squamosal—a character that seems distinct in this species.

The left lower jaw is quite complete. Although most of the alveolar portion is broken away, the inferior margin is complete. The post-prementary length therefore is known. When compared with the jaw of *S. albertensis*, the coronoid portion of the dentary is seen to be more robust and the dentary is shorter and has greater depth. The lower portion and the very tip of the prementary are known but display no distinctive features.

In order to restore our new skull it became necessary to visit Ottawa to study and to make comparisons with the type specimen. This was done by the senior writer, and was made possible through the courtesy of the National Museum of Canada officials, and Mr. Charles M. Sternberg in charge of the vertebrate collection.

In the original description Lambe comments on the distortion of the skull, through vertical pressure, and the consequent overlapping of bones in the anterior part of the skull. In his restored outline, side view, of the skull (Lambe, 1913, Pl. XII), however, the maxillary has not been given sufficient depth anteriorly, and the premaxillary crushing has not been corrected. By actual measurement of overlap between the nasal and premaxillary this specimen shows that originally the narial opening was almost circular, as in *Monoclonius* and *Centrosaurus*. The nasal horn has been crushed downward and forward at the base, and the posterior and anterior contour at the broken upper end shows clearly that it was not a straight blunt forward pitching element as restored. The terminal end has been restored approximately three inches too long.

In outline, the front part of this skull and the nasal horn should approximate the form of *Monoclonius nasicornus* Brown. Lambe's outline of the corrected position of the frill is approximately right with exception of the long posteriorly directed terminal spikes which have been restored incorrectly in form. Following the contour of the preserved bases, the terminal ends probably should curve forward laterally to a greater degree than they are restored, and should be somewhat reduced in length.

Taking these features of the type into consideration and using it as the principal guide, the skull of *Styracosaurus parksi* has been restored as shown in Fig. 3. Knowing the length of the jaw and parts of the prementary and rostral, it was possible to estimate the antorbital skull length, and the well-preserved jugal, quadratojugal, and quadrate indicate that that region is quite deep as in *Monoclonius*. The complete squamosal in articulation with the jugal, together with most of the lateral branch of the middle frill element, enabled us to make a close approximation of the frill length. The estimated length of the spikes is based on the size of the bases and on a fragmentary frill of another specimen (Amer. Mus. No. 5361) in the American Museum collection. The overlapping of the third by the second projection, however, is copied directly from the Ottawa specimen. It is entirely possible that these projections were equally spaced as is suggested in No. 5361, and as shown in *S. ovatus* Gilmore (1930, Pl. x), although it is certain that the first pair did not converge as in that species.

With the exception of coössified cervicals one, two, and the front part of three, the vertebral column is complete and articulated to and including the twentieth caudal. The tenth postcranial vertebra is the first to have the capitular facet on the neural arch, although that facet is somewhat lower down than on the remaining dorsal vertebrae. This vertebra is unquestionably the first dorsal. There are, therefore, nine cervicals and the number of dorsals is twelve. The centra of the fourth and fifth dorsals are coössified which is undoubtedly a pathological condition. This is not uncommon among the larger ceratopsia (Lull, 1933, p. 40), and may in some way be connected with the development of an unusually large head. Of especial note, in this connection, is the presence of ossified tendons across the neural spines of the anterior dorsal vertebrae. The twelfth dorsal is entirely free from the first sacral. It bears a long rib on either side which is entirely free from, and extends considerably below, the ilium. This is very different from the condition in *Monoclonius* (*Centrosaurus*) *flexus* in which the neural arch is fused to the first sacral and the ribs are short and united with the inferior sur-

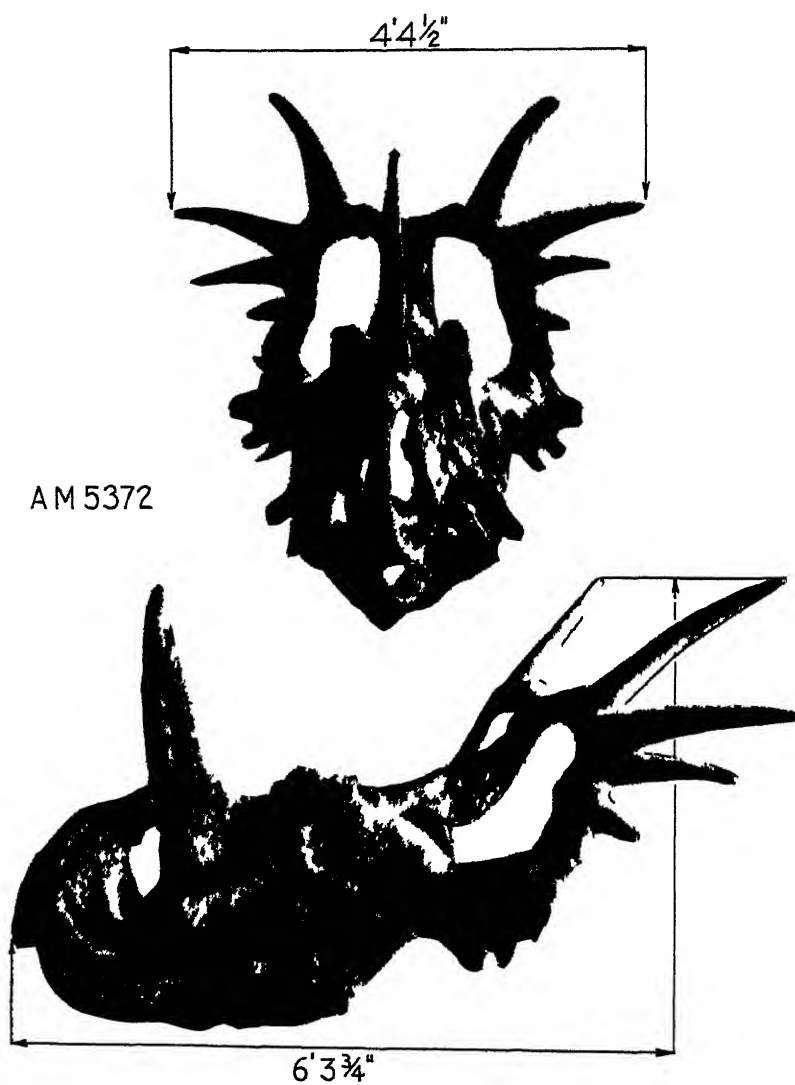


Fig 3 *Styracosaurus parksi*, new species Anterior and lateral views of the restored skull

faces of the ilia (Lull, 1933, p. 48). In *M. nasicornus* the ribs of the last dorsal are short and curve out in front of the ilia.

The sacrum is composed of ten vertebrae as is normal for all the later ceratopsians. A sacral character, however, that seems distinctive of *Styracosaurus* is that the tenth is incompletely fused with the ninth and retains the general form of the first caudal. In this respect the sacrum of *Styracosaurus* is more primitive than in *Monoclonius*, yet more advanced than in *Brachyceratops* which has eight sacrals (Gilmore, 1917, p. 21).

The first twenty caudals were all articulated and completely preserved. Twelve complete, and parts of three other caudal centra are also present. These have been placed, and the total number has been restored to forty-six, following that of *Monoclonius nasicornus*. As in that species, the first chevron appears between the third and fourth caudals. The only distinctive feature of the caudal series is the rapid reduction in size of the vertebrae. The first three are about as in *Styracosaurus albertensis*, but the fifth, sixth, seventh, and eighth are about one fourth smaller than in that species.

The pelvis of *Styracosaurus* displays several distinctive features. The ilium is proportionately wider anterior to and across the crest above the acetabulum than in *Monoclonius*, which character is in keeping with the large size of the animal. The posterior portion is not as outwardly deflected, nor is it as extended posteriorly. It is quite erect, short, and heavy, more as in *Brachyceratops*. In this respect the ilium is primitive—a condition to be expected in a ceratopsian in which only nine of the sacral vertebrae are firmly coössified, instead of ten as in such forms as *Monoclonius* and *Triceratops*.

The "prepubis" is stronger and the distal end is more expanded than in *Monoclonius*. This feature, however, is probably of little or no phyletic significance, since such an expansion simply means the presence of greater abdominal support,—a corollary of size increase.

These primitive conditions of the pelvis are likewise expressed in the ischium. Compared with the ischium of *Monoclonius*, this element displays some rather marked differences. It is heavier, especially in the distal portion, less decurved, and the antero-inferior projection for articulation with the pubis is not as extended. In addition, the notch between the pubic and iliac facets is deeper. Also, the distal end is not deflected inward—a feature particularly well shown in *M. cutleri*. All these characters seem to show that the *Styracosaurus* ischium is closer to that of *Brachyceratops* than to *Monoclonius*.



Fig. 4. *Syracosaurus parksi*, new species. Right view of the mounted skeleton.



Fig. 5. *Syracosaurus parksi*, new species. Left view of the mounted skeleton.

The appendicular skeleton is completely preserved although lateral crushing has caused a considerable amount of variation in the dimensions of the same elements on opposite sides. It is strikingly like that of *Monoclonius*. The only apparent differences are, that the second digit of the hind foot is proportionately somewhat longer, and the proximal end of metacarpal II is wider than that of metacarpal III. So very similar are the feet in the two genera that a front and hind foot of this skeleton, designated as *Monoclonius* sp., was prepared and illustrated as a check on the carpals and restored parts of the metacarpals in the senior writer's description of the type skeleton of *M. nasicornus* (Brown, 1917, Pl. XII). Apart from these slight differences and the distinctive features of the skull and pelvic bones, the remainder of the skeleton in nearly every way resembles *Monoclonius* so closely that if individual bones were found separately one could not determine which genus they represent.

In preparing and mounting the skeleton the bones have been retained in the exact position and association as found with exception of the right femur, which had been crowded through to the left side, and the left front limb which was found disarticulated. This limb has been posed to give balance to the mount (see Figs. 4 and 5).

This new species is the third to be assigned to *Styracosaurus*¹ and aids greatly in elucidating the characters of the genus, which originally were based on the skull alone and were given by Lambe (1913, p. 109) as follows:

"Skull massive, elongate, pointed in front, and greatly extended behind to form a neck-frill with long, robust, tapering outgrowths projecting obliquely backward and outward from its posterior border. Fontanelles of moderate size within the coalesced parietals. Squamosals somewhat quadrangular and entering largely into the formation of the front part of the frill. Postfrontal fontanelle large. Supratemporal fossa opening widely behind. Nasal horn-core large, upright, straight, rising from the back of the nasals. Supraorbital horn-core incipient."

Since the frill processes III in *Styracosaurus ovatus* Gilmore converge instead of diverge at their tips it would seem that the part of the above definition concerning the back region of the frill should be given as, "neck-frill with long, robust, tapering outgrowths projecting from its

¹ Lambe referred *Monoclonius sphenoceros* Cope, of which only the nasal with the horn, and the left premaxillary are known, to the genus *Styracosaurus*. We are of the opinion, expressed earlier by the senior writer (1914, pp. 549-550), that this species belongs to *Monoclonius* and should probably be referred to *M. crassus*. Lull (1933, pp. 90-91) has also stated his reasons for assigning this species to *Monoclonius*.

posterior border" instead of, "... projecting obliquely backward and outward from its posterior border." Otherwise the above characters, in view of the known material, should stand as given, and to them the following skeletal characters can be added: ninth and tenth sacrals incompletely coössified; posterior portion of ilium short and quite erect; and, ischium not greatly decurved. In these skeletal features *Styracosaurus* seems nearer to *Brachyceratops* than to *Monoclonius*, but in all other characteristics it is evidently most closely related to the latter, and probably represents an aberrant offshoot from the *Brachyceratops-Monoclonius* line.

MEASUREMENTS

	Right	Left
Length of Metacarpal I.....	81 mm.	92 mm.
" " Metacarpal II.....	133 mm.	133 mm.
" " Metacarpal III.....	133 mm.	140 mm.
" " Metacarpal IV.....	102 mm.	106 mm.
" " Metacarpal V.....	86 mm.	80 mm.
Length of Phalanx I ¹	52 mm.	55 mm.
" " Phalanx I ²	68 mm.	75 mm.
" " Phalanx II ¹	42 mm.	44 mm.
" " Phalanx II ²	31 mm.	33 mm.
" " Phalanx II ³	58 mm.	65 mm.
" " Phalanx III ¹	42 mm.	00 mm.
" " Phalanx III ²	29 mm.	29 mm.
" " Phalanx III ³	19 mm.	00 mm.
" " Phalanx III ⁴	44 mm.	49 mm.
" " Phalanx IV ¹	38 mm.	00 mm.
" " Phalanx IV ²	25 mm.	00 mm.
" " Phalanx IV ³	16 mm.	00 mm.
" " Phalanx V ¹	43 mm.	43 mm.
" " Phalanx V ²	13 mm.	00 mm.
Length of Metatarsal I.....		128 mm.
" " Metatarsal II.....		188 mm.
" " Metatarsal III.....		224 mm.
" " Metatarsal IV.....		178 mm.
" " Metatarsal V.....		68 mm.
Length of Phalanx I ¹		105 mm.
" " Phalanx I ²		95 mm.
" " Phalanx II ¹		70 mm.
" " Phalanx II ²		50 mm.
" " Phalanx II ³		88 mm.

	Left
Length of Phalanx III ¹	65 mm.
" " Phalanx III ²	40 mm.
" " Phalanx III ³	39 mm.
" " Phalanx III ⁴	87 mm.
" " Phalanx IV ¹	64 mm.
" " Phalanx IV ²	40 mm.
" " Phalanx IV ³	30 mm.
" " Phalanx IV ⁴	24 mm.
" " Phalanx IV ⁵	64 mm.
Length of humerus.....	618 mm.
" " radius.....	375 mm.
" " ilium (estimated).....	997 mm.
" " pubis and prepubis (estimated).....	598 mm.
" " ischium.....	890 mm.
" " dentary.....	405 mm.

REFERENCES

- BROWN, B. 1914. 'A complete skull of *Monoclonius*, from the Belly River Cretaceous of Alberta.' Bull. Amer. Mus. Nat. Hist., XXXIII, pp. 549-558.
1917. 'A complete skeleton of the horned dinosaur *Monoclonius*, and description of a second skeleton showing skin impressions.' Bull. Amer. Mus. Nat. Hist., XXXVII, pp. 281-306.
- GILMORE, C. W. 1917. '*Brachyceratops*, a ceratopsian dinosaur from the Two Medicine formation of Montana with notes on associated fossil reptiles.' U. S. Geol. Surv., pp. 103, pp. 1-45.
1930. 'On dinosaurian reptiles from the Two Medicine formation of Montana.' Proc. U. S. National Mus., LXXVII, pp. 1-39.
- LAMBE, L. 1913. 'A new genus and species of Ceratopsia from the Belly River Formation of Alberta.' Ottawa Naturalist, XXVII, pp. 109-116.
- LULL, R. S. 1933. 'A revision of the Ceratopsia or horned dinosaurs.' Mem. Peabody Mus. Nat. Hist., III, pp. 1-175.
- MATTHEW, W. B. 1916. 'A marsupial from the Belly River Cretaceous. With critical observations upon the affinities of the Cretaceous mammals.' Bull. Amer. Mus. Nat. Hist., XXXV, pp. 477-500.

AMERICAN MUSEUM NOVITATES

Number 956

Published by
THE AMERICAN MUSEUM OF NATURAL HISTORY
New York City

Nov. 1, 1937

A GATUN OSTRACODE FAUNA FROM CATIVA, PANAMA

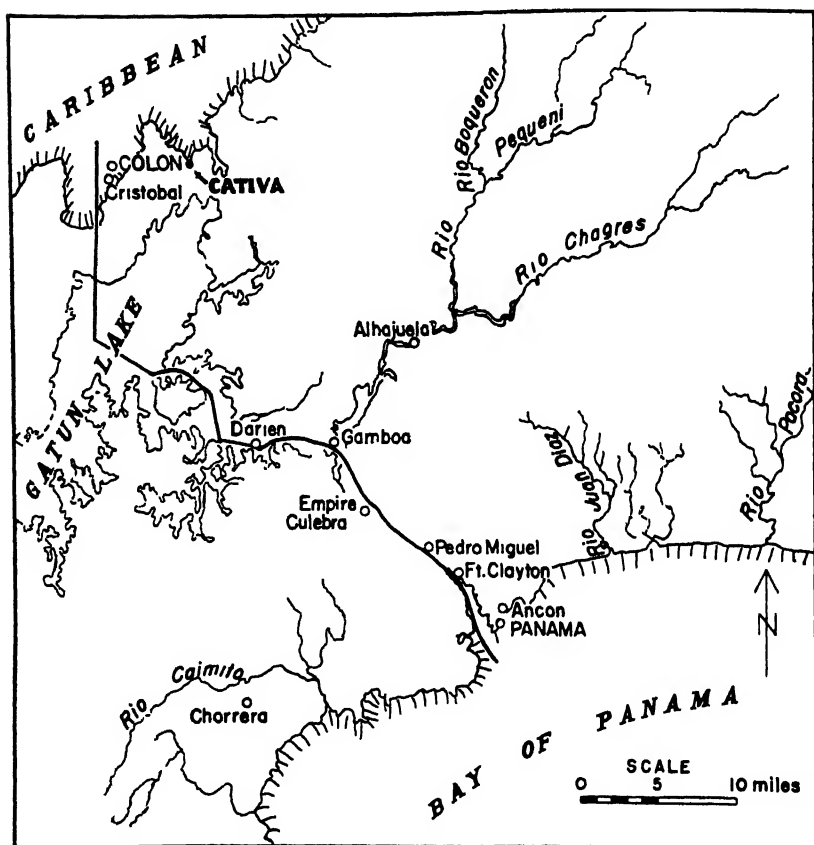
By H. N. CORYELL AND SUZANNE FIELDS

The material from which this fauna is described was collected by Captain John Embich during September, 1934, from a marl formation in the town of Cativa, located five miles east of Colon, on a small inlet of the Caribbean sea. The beds dip gently to the north at an angle of 10°–12°. They are very fossiliferous. The fauna consists of gastropods, cephalopods, pelecypods and bryozoa as the macrofossils with many foraminifera and ostracoda as the microfossils. The determination of the age of this marl as Lower Gatun is on the basis of specimens identified as *Clementia dariena* (Conrad), which, in the opinion of Woodring, is confined to the Lower Zone of the Gatun formation.

The fauna, itself, is noteworthy because of the occurrence in it of many new specimens with very definite recent affinities. The less ornamented and smooth shelled forms are much like living ostracodes, both in hinge structure and in the features of the inner lamella. Specialization is evidenced by the extremely ornate specimens, and the presence of similar ornamentation in unlike forms such as *Cativella naves* and *Navecythere delicata*. The definite appearance of modernistic trends and the occurrence of such a high degree of ornamentation indicate that in the Caribbean region rapidly changing environmental conditions accompanied the diastrophic movements which were in progress at that time.

The following table shows the position of the Cativa marl formation in the geological classification.

MIOCENE		
Upper	Middle	Lower
Toro limestone	Gatun formation	Emperador limestone
	Upper	Upper Culebra formation
	Middle	
	Lower— <i>Cativa marls</i>	
	Vamos-a-vamos	



Map of Panama Canal Zone showing the location of the Cativa collecting locality.

CLASSIFICATION AND DESCRIPTION OF THE OSTRACODA

PLATYCOPA SARS, 1865 (1866)

Cytherellidae Sars, 1865 (1866)

CYTHERELLOIDEA ALEXANDER, 1929

Cytherelloidea leonensis Howe, 1934

Figures 1a, b, c, d

HOWE, H. V., 1934, Jour. Paleo., Vol. 8, No. 1, p. 34, Pl. v, fig. 9.

MORPHOTYPES.—A. M. N. H. Cat. No. 24885.

The specimens of this species vary in the posterior thickness. This difference is interpreted as a sexual characteristic.

PLATELLA, NEW GENUS

GENOTYPE.—*Platella gatunensis*, new species.

Carapace small, thin-shelled, pellucid, subquadrate, ornamented with numerous pits and a median, subdorsal shallow sulcus. Right valve receives left in a shallow groove and overlaps it on the dorsal and ventral margins. Groups of irregular shaped muscle scars are located on the interior surface of the sulcus.

The thin-shelled feature and the ornamentation distinguishes this genus from *Cytherella* and *Cytherelloidea*.

***Platella gatunensis*, new species**

Figures 2a, 2b

Carapace small, thin-shelled, subquadrate to broadly ovate; greatest thickness near the center of the posterior half. The convexity of the valve is ornamented by numerous pits that show some alignment near the ventral border and about the shallow, median, subdorsal sulcus. Within the shallow valves and upon the lower extension of the sulcus are four groups of muscle scars. The inner margin of the right valve is grooved to receive the slightly flanged margin of the left valve. The flange is widest and the groove deepest in the mid-dorsal portion.

LENGTH.—0.42 mm. HEIGHT.—0.2 mm.

TYPES.—A. M. N. H. Cat. No. 24886.

PODOCOPA SARS, 1865 (1866)

Cypridae Baird, 1846 (1849)

Macrocyprinae Müller, 1912

MACROCYPRIS BRADY, 1867 (1868)

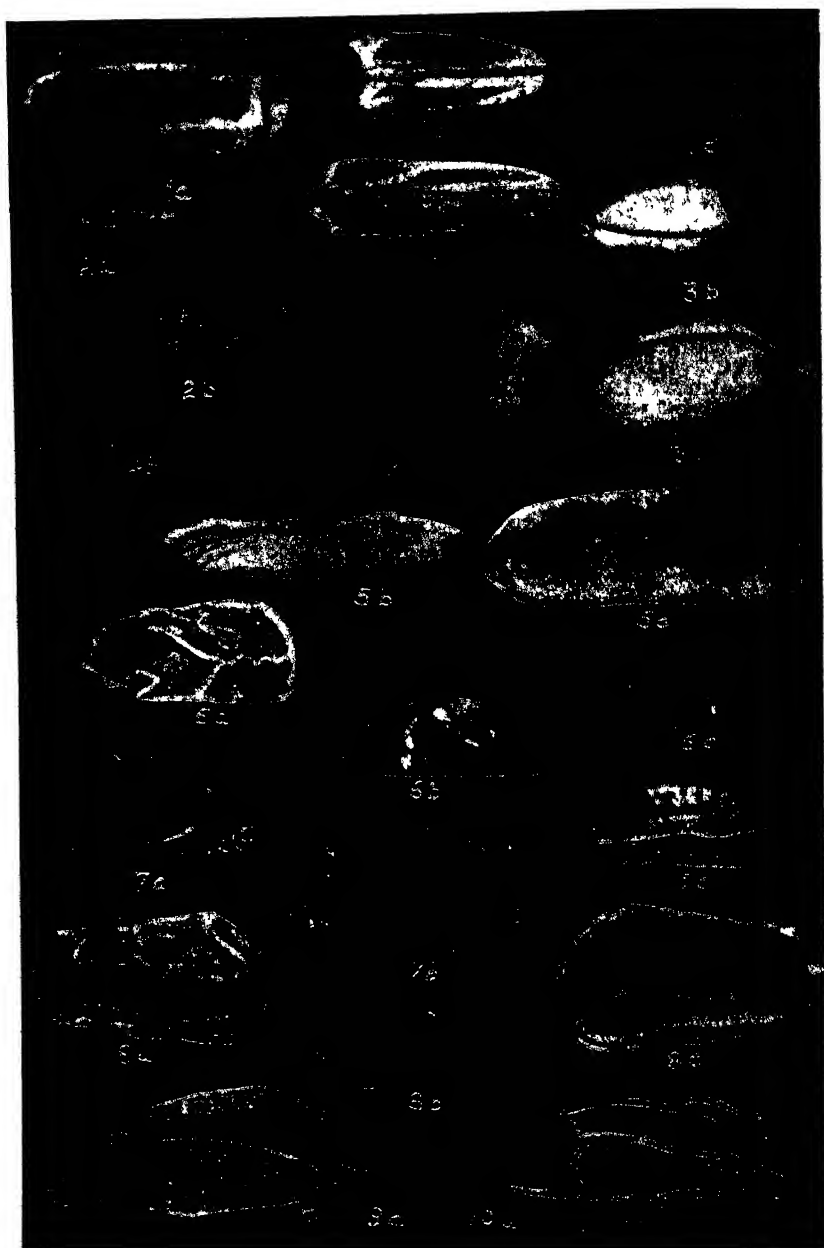
***Macrocypris dreikanter*, new species**

Figures 4a, 4b

Carapace elongate, small, smooth, pellucid, thin-shelled; broadly rounded anterior margin; ventral margin nearly straight; dorsal margin obtusely angulated with a long posterior slope extending to the subacute posterior border. Greatest height in anterior half; greatest thickness anterior to the greatest height and near the mid-line. The length is more than twice the height. Right valve overlaps the left along the dorsal and midventral borders. The ventral overlap forms a wide cuneate flange. Three elongate parallel muscle scars occur just posterior to the position of greatest thickness.

LENGTH.—0.65 mm. HEIGHT.—0.32 mm.

TYPES.—A. M. N. H. Cat. No. 24887.



See opposite page for captions:

Bairdiidae Sars, 1887**Bairdiinae Sars, 1923****BAIRDIA McCoy, 1844****Bairdia colonensis, new species**

Figures 3a, 3b

Carapace small, translucent; finely perforated by pore canals; greatest height slightly anterior to the center of the valve. The dorsal margin is broadly arched; the ventral nearly straight; the posterior margin is acuminate below the angulation

(Captions for Figures 1-10)

- Fig. 1. *Cytherelloidea leonensis* Howe, $\times 75$.
a. Left valve of Morphotype, lateral view.
b. Ventral view of female.
c. Dorsal view of male.
d. Interior, right valve.
- Fig. 2. *Platella gatunensis*, n. gen., n. sp., $\times 65$.
a. Dorsal view of left valve.
b. Lateral view, left valve.
- Fig. 3. *Bairdia colonensis*, n. sp., $\times 85$.
a. Lateral view, left valve.
b. Dorsal view.
- Fig. 4. *Macrocypris dreikanter*, n. sp., $\times 65$.
a. Lateral view, left valve.
b. Dorsal view.
- Fig. 5. (?) *Cythere mylonita*, n. sp., $\times 110$.
a. Lateral view, right valve.
b. Dorsal view of right valve.
- Fig. 6. *Paracytheridea clara*, n. sp., $\times 70$.
a. Lateral view, right valve.
b. Dorsal view of right valve.
c. Ventral view of right valve.
- Fig. 7. *Navecythere delicata*, n. gen., n. sp., $\times 65$.
a. Lateral view, left valve.
b. Lateral view of a right valve.
c. Ventral view of right valve, showing dentition.
- Fig. 8. *Favella puella*, n. gen., n. sp., $\times 70$.
a. Lateral view, right valve.
b. Dorsal view of right valve.
c. Interior of right valve.
- Fig. 9. *Cativella navis*, n. gen., n. sp., $\times 100$.
a. Lateral view, right valve.
- Fig. 10. *Cythereis vaughani* (Ulrich and Bassler), $\times 60$.
a. Lateral view, right valve.

where the valves gape slightly; the anterior, gently curved below and straight above. The dorsal view presents a regular spindle shape.

LENGTH.—0.41 mm. HEIGHT.—0.2 mm.

TYPES.—A. M. N. H. Cat. No. 24888.

Cytheridae Baird, 1850

Cytherideinae Sars, 1925

CYTHERE MÜLLER, 1785

? *Cythere mylonita*, new species

Figures 5a, b

Carapace small, extremely elongate, somewhat reniform, and pellucid. Dorsal margin straight and slightly depressed; anterior margin broadly rounded dorsally and more narrowly rounded ventrally; posterior margin more narrowly rounded at the mid-height; ventral margin slightly concave near the central portion where the left valve slightly overlaps the right. A narrow rim borders the free margin. The greatest height is near the anterior cardinal angle; greatest thickness is near the middle of the line of greatest height. The convexity of the valve is marked by three or more low transverse ridges that parallel the posterior margin and a lesser number that parallel the anterior margin; low papillae, shallow depressions, numerous small, shallow pits, and openings to pore canals ornament the surface. These outside features are also distinguishable upon the inside of the valve.

A recumbent marginal area is present within the valves. It is broad in the anterior and much less developed along the ventral and posterior.

The hingement of the right valve consists of a narrow bar near each cardinal angle; the anterior bar is divided into four blunt cusps and the posterior into six. The two bars are connected by a line-like pitted groove, which lies near the slightly flanged dorsal margin. The hingement of the left valve consists of elongate terminal pitted sockets connected by a finely crenulated bar as complements of the structures in the right valve.

LENGTH.—0.42 mm. HEIGHT.—0.12 mm.

TYPES.—A. M. N. A. Cat. No. 24889.

PARACYTHERIDEA MÜLLER, 1894

Paracytheridea clara, new species

Figures 6a, b, c

Carapace elongate-quadrate, small, thin, translucent, irregularly alate. The straight dorsal and ventral margins converge distinctly posteriorly; greatest height near anterior cardinal angle; anterior margin broadly rounded; posterior margin dorsally and ventrally truncated, ending medially in a blunt flattened spine. The convexity of the valves is greatest ventrally where it is mounted with an alational ridge that is terminated in the posterior half by a spine, below which the surface slopes perpendicularly to the ventral contact. Transverse shallow depressions and ridge-like flexures ornament the surface above the alation. Posteriorly the con-

vexity is irregularly depressed, converging into the terminal spine; in the anterior half is a median horizontal ridge that bifurcates at a subcentral node, the ventral branch joining the alai al carinae near its mid-point, the dorsal branch cutting obliquely across the shell to the posterior cardinal angle. The entire surface of the valve is perforated by numerous openings of minute canals. The ventral margin of the right valve is flanged, and sinuous just anterior to the middle.

Within, the valves are deep and irregular. A narrow marginal area is present along the anterior margin. The hingement of the right valve consists of a shallow, pitted groove adjacent and parallel to the dorsal margin, with a long, narrow, curved tooth at each end. The hinge structure of the left valve complements that of the right.

LENGTH.—0.40 mm. HEIGHT.—0.2 mm.

TYPES.—A. M. N. H. Cat. No. 24890.

NAVECYTHERE, NEW GENUS

GENOTYPE.—*Navecythere delicata*, new species.

Carapace, small, thin, subtriangular; highest anteriorly; ventral overlap consists of alternate projections with the right valve possessing the median flange. Ornamentation is of delicate submarginal perforated keels and conical spines. The hinge pattern of the right valve consists of terminal, cardinal, blade-like, crenulated teeth, with a narrow pitted groove that opens interiorly at its posterior end, lying between the teeth. The left valve possesses complementary structures of sockets and marginal crenulated ridge.

This genus differs from *Cythereis* in the extreme thinness of the shell material, absence of the interior marginal area, the characteristic hingement, and peculiar ornamentation.

Navecythere delicata, new species

Figures 7a, b, c

Carapace thin, translucent, subtriangular, highest at the anterior cardinal angle, thickest in the posterior half; the dorsal contact is straight; the ventral marginal contact is sinuous about the alternate projection of the left, right, and then left valves, which arrangement forms the ventral overlap feature; the anterior margin is broadly rounded; the posterior margin is acuminate. A submarginal, rather irregularly perforated flange ornaments the surface, except along the dorsal posterior where it is absent, and along the ventral posterior, where a few curved, conical spines are present. This flange is interrupted in *en echelon* manner near the median dorsal; its posterior dorsal portion is located slightly more ventrally than the anterior portion. A short, perforated flange rises from the surface of the valve in the ventral half; it lies parallel to the ventral margin and ends posteriorly in a spine-like projection. Minute openings of pore canals are abundant over the convexity of the valve.

The hingement of the right valve consists of an anterior cardinal, long, blade-like, crenulated tooth on the dorsal margin, and a posterior cardinal, triangular tooth that extends a short distance down the posterior slope, with a narrow, finely

pitted groove between the teeth which opens interiorly at its posterior end. The hingement structure in the left valve consists of complementary cardinal socket-pits and a crenulated dorsal shell margin to fit the structures of the right valve.

LENGTH.—0.38 mm. HEIGHT.—0.22 mm.

TYPES.—A. M. N. H. Cat. No. 24891.

This species is common in the Gatun.

FAVELLA, NEW GENUS

GENOTYPE.—*Favella puella*, new species.

Carapace small, thin, translucent, subquadrate, with straight dorsal margin; greatest height near the anterior cardinal angle. Interior marginal area narrow, with short radial pore canals along the anterior border.

Hingement of right valve consists of terminal, long, blade-like teeth at the cardinal angles, connected by a narrow pitted groove parallel and adjacent to the dorsal margin. The hinge structures of the left valve are complements of the right; the terminal sockets are formed by the dorsal margin curving upward over the teeth of the right valve. The crenulated dorsal margin serves as a ridge to fit into the groove.

The surface is moderately ornamented with spines, nodes and irregular ridges.

Favella puella, new species

Figures 8a, b, c

Carapace small, subquadrate, thin, translucent, moderately ornamented; greatest height at the anterior cardinal angle, greatest thickness through the subcentral node. Dorsal margin almost straight; anterior margin broadly rounded, slightly flattened in the upper half; ventral margin concave anterior to the middle, otherwise nearly straight; posterior margin is broadly rounded and is marked by four or five short, blunt spines. The free margin is bordered by a narrow rim, parallel to which in the anterior, there is a narrow sharp flange. Parallel to the ventral margin on the lower half of the shell is a ridge, above which there are three short ridges in the anterior part of the valve that converge on the subcentral node, while a single ridge continues backward from the node along the mid-line. The anterior half of the surface of the valve is additionally ornamented by a fine, line-like reticulation; the posterior is ornamented by irregularly placed small knobs and spines. Many minute pores puncture the surface.

An interior marginal area occurs within the anterior end with a few short radial pore canals. The free margin of the left valve bears a groove, deepest at the mid-ventral area; the right valve possesses a flanged panel which fits into the groove.

The hingement of the right valve consists of a long, blade-like anterior cardinal tooth that is raised above the dorsal margin, and a posterior cardinal, flattened, angled, tooth that extends a short distance down the posterior slope. Between the teeth is a narrow pitted groove. The left valve has complementary hinge structure, with cardinal sockets formed by the outward curving of the dorsal margin, and, between the sockets, the finely crenulated dorsal margin arranged to fit into the groove of the right valve.

LENGTH.—0.49 mm. HEIGHT.—0.25 mm.

TYPES.—A. M. N. H. Cat. No. 24892.

This species is very common in the Gatun.

Cytherinae Dana, 1852

CATIVELLA, NEW GENUS

GENOTYPE.—*Cativella navis*, new species.

Carapace medium sized, subtriangular, thick-shelled, with anterior end broadly rounded and posterior end acuminate with marginal spines. Hinge structure is similar to that of the genus *Cythereis*. The surface of the valve is ornamented with conspicuous, perforated, submarginal and other longitudinally arranged flanges; inner marginal area and platform are present with unequally distributed radial pores. The inequality of the valves shows externally where the mid-ventral flange of the right valve fits into the rabbeted edge of the left.

The ornamentation of this genus presents an illustration of the principle of parallelism when it is compared to the genus *Navecythere*. The hinge structures of the two genera are quite different.

Cativella navis, new species

Figure 9a

Carapace subtriangular, thick, medium sized with the greatest height at the anterior cardinal angle; anterior end broadly rounded; posterior end acuminate and with an extended appearance; the contact margin is characteristically denticulate; the ventral posterior margin bears three or four long, conical, curved spines; the dorsal posterior possesses a single, short, stout spine. A submarginal rather regularly perforated, keeled flange is present on the dorsal, anterior, and ventral borders; two similar short flanges rise near the ventral anterior, one paralleling the ventral border flange ending in a spinous termination, and the other extending across the convexity of the valve near to the dorsal posterior; a few low, rounded knobs occur over the surface. The hingement is typical of the genus *Cythereis*; a well-developed eye spot is present; the marginal area is moderately broad, with the line of concrescence parallel to and near the inner margin. Radial pores are short, straight, but numerous only in the anterior end. The ventral overlap consists of the curved flange of the right valve fitting into the rabbeted mid-ventral margin of the left valve.

LENGTH.—0.56 mm. HEIGHT.—0.19 mm.

TYPES.—A. M. N. H. Cat. No. 24893.

This species is quite common in the Gatun.

CYTHEREIS JONES, 1849

Cythereis vaughani (Ulrich and Bassler), 1904

Figure 10a

Cythere vaughani ULRICH AND BASSLER, 1904, Md. Geol. Surv., Miocene, p. 109, Pl. XXXVIII, figs. 25-27.

Cythereis vaughani HOWE (and students), 1935, Fla. Geol. Surv., Bull. XIII, p. 25, Pl. III, figs. 24-26; Pl. IV, fig. 13.

MORPHOTYPE.—A. M. N. H. Cat. No. 24894.

This Gatun specimen differs in no important way from those described by both Howe and Ulrich and Bassler, which suggests the rather wide distribution of the species. Such forms as this suggest the correlation of the lower bed of the Gatun with the Choctawhatchee of Florida and the Chesapeake of Maryland.

Cythereis rugipunctata gatunensis, new variety

Figure 11a

Carapace is small, thick-shelled, elongate, quadrate, transparent; greatest height at anterior cardinal angle; greatest thickness at subcentral node; anterior margin broadly and obliquely rounded with small denticulations along the ventral portion; the ventral margin is nearly straight in the posterior three-fourths and broadly convex in the anterior one-fourth; the posterior margin is marked by four or five distinct blunt spines; the dorsal margin is nearly straight. The surface is ornamented by a subcentral node; a submarginal rim borders the anterior edge and the anterior ventral margin; a short rib rises near the anterior rim near the mid-line and trends backward upon the node where it trifurcates; many irregularly placed knobs are present on the anterior and posterior convexity of the valve. In places on the posterior these nodes are aligned transversely forming a pattern clearly related to *Cythereis rugipunctata*. The eye spot is marked by a translucent knob near the cardinal end of the anterior rim.

The inner marginal area is moderately broad, widest along the posterior ventral; the line of concrescence almost coincides with the inner margin; the platform is widest in the anterior ventral. The free contact border of the right valve is marked with a groove into which a panel on the left valve fits. Radial pore canals are found on the anterior, ventral and posterior borders.

The hingement is typical for the genus.

LENGTH.—0.60 mm. HEIGHT.—0.18 mm.

TYPES.—A. M. N. H. Cat. No. 24895.

CAUDITES, NEW GENUS

GENOTYPE.—*Caudites medialis*, new species.

Carapace small, thick-shelled, translucent, subtriangular in side view, a thickened marginal rim and a ventral posterior caudal projection. Hingement structure in right valve consists of a high anterior knob-like tooth behind which is a deep socket which becomes narrower and shallower posteriorly, trending obliquely toward the dorsal margin near the mid-point of the hinge where the shallow socket disappears; a narrow groove continues backward parallel and below the dorsal margin to the posterior cardinal angle. The socket and narrow groove are both pitted. The dorsal margin is slightly flanged. In the posterior cardinal angle the dorsal margin is occupied by a large flat, triangular tooth which extends some distance down the posterior slope.

The hingement of the left valve is a complement of the right. A large eye spot is present anterior to and below the anterior dentition. The inner marginal area and radial pore canals are present.

It is believed that *Hemicythere sellardsi* Howe and Neill is a member of this genus.

Caudites medialis, new species

Figures 12a, b, c, d

Carapace small, thick-shelled, elongate, subtriangular in side view; dorsal margin convexly sinuous; ventral margin concave anterior to the middle, otherwise straight; anterior end broadly rounded; posterior end obliquely truncated above and produced to a blunt caudal projection below; greatest height at the anterior cardinal angle; left valve overlaps the right on the ventral margin in the concave portion.

The ornamentation consists of two ridges paralleling the ventral margin; the inner one continues forward and becomes the marginal anterior ridge; it ends in the posterior quarter of the valve; the marginal one of the two rises in the ventral anterior, extends around the caudal projection, and ends in a blunt spine near the dorsal cardinal angle; an anteriorly curved transverse ridge crosses the valve below the posterior cardinal angle; a median longitudinal ridge rises from the posterior transverse one just above the middle and extends toward the anterior marginal ridge, bifurcating near the middle of the anterior half, one limb extending slightly upward to the anterior margin and the other, which is larger, extending to the anterior ventral curvature of the submarginal ridge.

Within, the valves are shallow and smooth, with a moderately broad marginal area, a narrow platform, and many short straight radial pore canals. The free contact of the valves is rabbeted; the right valve bears a sharp ridge near the center of the marginal area, which is developed into a prominent flange that curves inward just anterior to the middle of the ventral margin with a sharply defined narrow groove below it.

The hinge structure in the right valve consists of a high, knob-like anterior tooth, behind which a deep, oblique socket extends near to the middle of the valve where it gradually narrows to an incised groove that extends to the posterior cardinal tooth. The socket and groove are finely pitted. The dorsal margin of the valve is flanged above the groove. The posterior cardinal tooth is a large, flattened, triangular one that extends some distance down the posterior slope. The hingement of the left valve is a complement of the right.

An eye spot occurs below the anterior dentition.

LENGTH.—0.45 mm. HEIGHT.—0.20 mm.

TYPE.—A. M. N. H. Cat. No. 24896.

BASSLERITES HOWE, 1937, NEW NAME

The generic name *Basslerites* is presented at the suggestion of Dr. Howe to replace his generic name *Basslerella* which was used previously by Betty Kellett Nadeau in March, 1935, to designate a group of Ostracoda, quite different from the Miocene forms.

Basslerites miocenicus (Howe), 1935

Figures 13a, b

Basslerella miocenica HOWE, 1935, Fla. Geol. Surv., Bull. XIII, pp. 30-31, Pl. 1, figs. 19, 24-26.

MORPHOTYPES.—A. M. N. H. Cat. No. 24897.

This species is relatively common in the Gatun localities of Panama.

Cytherurinae Müller, 1894**CYTHERURA** Sars, 1865 (1866)**Cytherura bananaformis**, new species

Figures 14a, b, c, d

Carapace small, thin-shelled, highly translucent; the length is almost three times the height; dorsal margin is gently arched; anterior margin narrowly curved, especially near the ventral margin; ventral margin is convex anteriorly and posteriorly, and distinctly concave medially where the left valve overlaps the right; posterior margin borders the laterally compressed, nasute, downwardly curved, caudal termination of the valves. Two broad, shallow, transverse depressions cross the valves on each side of the mid-area; seven or more distinct, narrow, longitudinally arranged, raised striae converge somewhat near the anterior and posterior ends, the border ones joining around the crest of the abrupt posterior slope; numerous small pits are irregularly distributed over the surface of the valve; other smaller openings to pore canals dot the surface.

The hinge structure is delicate, and consists, in the right valve of an elongate anterior curved socket which parallels the dorsal margin and opens posteriorly into the interior cavity of the valve; the post-dorsal margin is slightly flanged; the hinge-ment of the left valve consists of an anterior tooth, long, narrow, and blade-like, which continues posteriorly as the dorsal margin; immediately below and parallel to this margin is a narrow groove which opens to the interior at the posterior cardinal angle; the inner marginal area is very broad in the anterior and posterior areas, very narrow near the mid-ventral margin and absent along the dorsal border. The inner platform lies close to the shell in the posterior portion, and rather widely separated from it in the anterior ventral portion; the inner margin is sinuous.

LENGTH.—0.34 mm. HEIGHT.—0.14 mm.

TYPE.—A. M. N. H. Cat. No. 24898.

Loxoconchinae Sars, 1926**KANGARINA**, NEW GENUS

GENOTYPE.—*Kangarina quellita*, new species.

Carapace small, pellucid, thick-shelled, subquadrate, with a subdorsal caudal projection; dorsal margin straight, shorter than the ventral margin, but almost parallel to it; anterior margin extends most in the ventral half; the valves are flattened along the ventral area. The ornamentation consists of a marginal ridge

and an open loop in the ventral half, with a restricted distribution of surface pits. The inner marginal area is conspicuously developed, with a variable arrangement of pore-canals; an interior tunnel structure is present. The hingement of the left valve consists of a median, crenulated bar with a single, long, narrow, obliquely arranged, crenulated tooth at each end. A narrow abutment is developed above and below the bar. The hingement of the right valve consists of structural complements of the left with the inner wall of the groove, narrow and bearing coarse terminal crenulations, and the dorsal wall formed into a heavy bar that rests against the abutment in the left valve.

This genus is separated from *Cythere* by the longer and greater development of the hinge teeth, the presence of both groove and sockets in the left valve, and the peculiar exterior ornamentation. Two species of this genus have been recognized, one of which is described here. The forms are quite rare in the Gatun material.

Kangarina quellita, new species

Figures 15a, b, c

Carapace small, translucent, thick-shelled, with a blunt, subdorsal caudal projection; anterior margin truncated dorsally and narrowly rounded ventrally; dorsal margin straight and much shorter than the ventral margin; ventral margin almost straight with the ventral surface of the valve flattened; posterior margin is truncated ventrally and dorsally, both borders curving posteriorly to form the caudal projection in the dorsal half. A marginal rim borders the valve, less prominent on the posterior margin than elsewhere. A loop-shaped ridge, that opens forward into an extended channel occurs in the posterior ventral one-fourth; posterior to the middle a transverse ridge extends from the dorsal margin to the upper edge of the loop; the surface of the valve is marked by irregular reticulations except within the loop where it is relatively smooth.

The inner marginal area is broadly developed as an inner lamella, leaving only an oval area in the posterior part of the anterior half uncovered; in the anterior the line of concrescence parallels the border with several radial pore canals present; the inner extension of the lamellar platform rises sufficiently above the surface of the valve in the posterior ventral area to form a tunnel-like structure that opens anteriorly into the lower portion of the uncovered oval area.

The hingement of the left valve consists of a short, thin, crenulated bar with single, long, narrow, obliquely arranged, crenulated tooth at each end; a narrow abutment lies above the bar and parallel to the dorsal margin; the right valve hinge structure consists of terminal pitted sockets and a connecting groove with a lower wall that is very narrow and that bears coarse terminal crenulations, and a dorsal wall that is much heavier and formed to meet the abutment in the left valve.

LENGTH.—0.36 mm. HEIGHT.—0.18 mm.

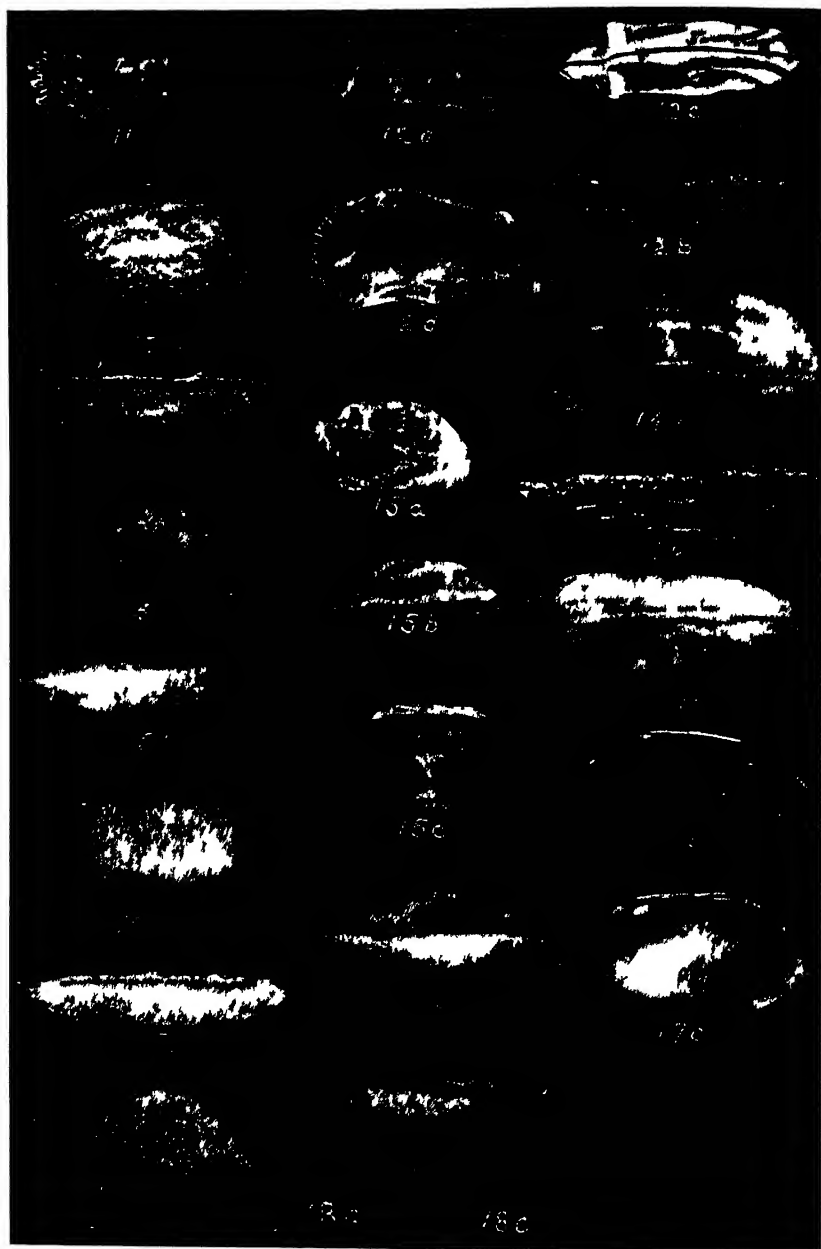
TYPE.—A. M. N. H. Cat. No. 24899.

Bythocytherinae Sars, 1926

LUVULA, NEW GENUS

GENOTYPE.—*Luvula palmerae*, new species.

Carapace thin-shelled, pellucid, somewhat bairdoid; the inner lamella is



See opposite page for captions

variably developed with a distinct line of concrescence and few to numerous radial canals where the inner marginal area is well developed.

The hinge of the left valve consists of an anterior and a posterior blade-like tooth connected by a narrow bar. The hingement of the right valve consists of a shallow anterior and posterior socket formed by extensions of the inner surface shell below the cardinal angles. The posterior cardinal area is slightly enlarged outwardly to receive the posterior tooth of the left valve.

The muscle scars are arranged in groups of irregular ovals in the dorsal half of the interior surface posterior to the middle, and, in the lower half of the valve, just

(Captions for Figures 11-18)

- Fig. 11. *Cythereis rugipunctata gatunensis*, n. var., $\times 70$
a. Lateral view, right valve.
- Fig. 12. *Caudites medialis*, n. gen. n. sp., $\times 65$.
a. Lateral view, right valve.
b. Dorsal view of right valve.
c. Ventral view.
d. Interior of a right valve.
- Fig. 13. *Basslerites miocenica* (Howe), $\times 75$.
a. Lateral view, right valve.
b. Dorsal view of right valve.
- Fig. 14. *Cytherura bananaformis*, n. sp., $\times 115$.
a. Lateral view, right valve.
b. Dorsal view of left valve.
c. Dorsal view.
d. Interior of right valve.
- Fig. 15. *Kangarina quellita*, n. gen., n. sp., $\times 75$.
a. Lateral view, right valve.
b. Dorsal view of right valve.
c. Interior of right valve.
- Fig. 16. *Luvula palmera*, n. gen., n. sp., $\times 100$.
a. Lateral view, left valve.
b. Dorsal view of left valve.
- Fig. 17. *Macrocytherina gatunensis*, n. gen., n. sp., $\times 70$.
a. Lateral view, left valve.
b. Dorsal view of left valve.
c. Interior of right valve.
d. Dorsal view.
- Fig. 18. *Pellucistoma howei*, n. gen., n. sp., $\times 75$.
a. Lateral view, right valve.
b. Dorsal view of left valve.
c. Lateral view, left valve.

anterior to these is a group of crescentic scars with the concave side toward the ventral margin.

Luvula palmerae, new species

Figures 16a, b

Carapace thin-shelled, somewhat bairdioid; dorsal margin straight; ventral margin concave in the anterior half and distinctly convex in the posterior where it curves upward to the posterior ventral acumination; the posterior margin above the caudal projection is only slightly convex as it rises steeply upward and forward to the posterior cardinal angle where the greatest height is located.

The inner lamella is broad along the anterior end and the posterior ventral area; the line of concrescence lies close to the ventral margin and in the anterior part of the valve it is near the inner margin of the lamella. The radial pore canals are numerous around the anterior end, and occur much less frequently in other areas. The muscle scars are arranged in two groups: four irregularly oval scars posterior to the middle in the dorsal half, and three somewhat parallel, crescentic scars in the lower half of the ventral area of the valve, just below and anterior to the mid-point of the valve.

The hinge structure is characteristic of the genus.

LENGTH.—0.50 mm. HEIGHT.—0.16 mm.

TYPES.—A. M. N. H. Cat. No. 24900.

Specimens of this species occur quite commonly in the material from the Gatun formation in Panama.

MACROCYPHERINA, NEW GENUS

GENOTYPE.—*Macrocytherina gatunensis*, new species.

Carapace thin-shelled, small, translucent; anterior margin broadly and somewhat obliquely rounded; posterior margin broadly curved except just below the mid-point where a small sharp caudal spine projects. The hinge structural elements are similar to those in *Luvula*, except much more strongly developed, and located farther toward the posterior; the dorsal margin is approximately parallel to the general trend of the ventral margin, which is concave slightly anterior to the middle and convex near its terminals; the anterior end is more protruding than in *Luvula* leaving the anterior cardinal angle quite far behind. The muscle scars are arranged in groups of fours in two somewhat oblique lines across the valve near the posterior of the anterior third of the valve.

Macrocytherina gatunensis, new species

Figures 17a, b, c, d

Carapace small, thin-shelled, reniform; dorsal margin nearly straight; anterior margin broadly, but somewhat obliquely rounded, the ventral portion extending farther forward; the posterior margin is broadly rounded above and below the caudal process that occurs a little below the mid-point.

Radial pore canals are well developed in the anterior inner marginal area; the

interior margin lies nearer the anterior ventral area than elsewhere. The right valve overlaps the left on the anterior cardinal angle and forms the sinuousness of the outer dorsal contact.

The hingement is characteristic of the genus.

The interior bears the two rows of muscle scars in an obliquely transverse arrangement. The individual muscle scars are small, irregular, oval-shaped, and occur in sets of fours.

LENGTH.—0.46 mm. HEIGHT.—0.22 mm.

TYPE.—A. M. N. H. Cat. No. 24901.

This species is quite abundant in the Gatun material from Cativa, Panama.

Paradoxostominae Müller, 1894

PELLUCISTOMA, NEW GENUS

GENOTYPE.—*Pellucistoma howei*, new species.

Carapace small, translucent, subovate, finely perforated surface, with a subdorsal posterior caudal projection; dorsal hinge line straight; anterior end obliquely and broadly curved. The marginal area is well developed, with few radial pore canals.

The hingement of the left valve consists of an anterior long blade-like triangular tooth, from which a long serrated bar extends backward and terminates at the posterior cardinal angle; above this bar and parallel to it is a narrow incised line-like groove. The hinge structure of the left valve fits into an anterior socket and crenulated groove of the right valve; the socket is formed by a tooth-like structure projecting from the inner surface just below the anterior cardinal angle, leaving the cavity open anteriorly and posteriorly; the posterior cardinal area of the right valve is somewhat angulated by the development, on the dorsal margin, of a sharp, small hook which receives the posterior end of the bar of the left valve.

The valves are apparently equal except in the mid-ventral margin where the valves are rabbeted.

A muscle scar pattern is distinguishable.

Pellucistoma howei, new species

Figures 18a, b, c

Carapace small, subovate, translucent, thin-shelled, finely perforated; with a subdorsal caudal projection that is well developed; dorsal margin short and straight; anterior end broadly round, projecting more forward near the ventral border than elsewhere; the free margin has apparently an equally formed contact, except along the concave portion of the ventral border where a panel flange of the right valve fits into the groove of the left valve; the posterior margin is broadly arched below the subdorsal projection and concave above it.

The inner marginal area is broad with fine, long, occasionally branching radial pore canals; the line of concrescence is quite irregular, approaching more closely to the outer margin at every pore canal, and lying near the inner margin elsewhere

forming a scalloped trace in complete outline. The hingement of the right and left valves is characteristic of the genus.

The muscle scar pattern lies in the anterior half of the valve and consists of a large round scar behind which lies a transverse irregular line of oval scars. Other irregular scars are found surrounding these well-developed ones.

LENGTH.—0.48 mm. HEIGHT.—0.27 mm.

TYPE.—A. M. N. H. Cat. No. 24902.

AMERICAN MUSEUM NOVITATES

Number 957

Published by
THE AMERICAN MUSEUM OF NATURAL HISTORY November 1, 1937
New York City

RESULTS OF THE ARCHBOLD EXPEDITIONS. NO. 17

SOME ORIGINAL OBSERVATIONS ON THE HABITS OF *DACTYLOPSILA TRIVIRGATA* GRAY

By A. L. RAND

The striped phalangers of the genus *Dactylopsila* are remarkable for an elongated finger on the fore paw and rodent-like teeth. One species, *D. palpator*, was used as the type of a new genus, *Dactylonax*, by Thomas¹ because of the extremely long and attenuated finger.

It has been said that the rodent-like teeth are used for gnawing out wood-boring grubs and the elongated finger is used for extracting the grubs from crevices.^{2 3 4} Though the present species is not the most specialized of its group, the fourth finger of the fore paw being only somewhat elongated and not much more slender than the others, my observations substantiate the above remarks on the habits of this group, which, apparently, have hitherto rested on deduction rather than observation.

Troughton⁵ has given a summary of the little that is known about the habits of the members of this genus and most of the following observations are new. These were made while I was with Mr. Richard Archbold's 1936 New Guinea Expedition. At Tarara, Wassi Kussa River, south New Guinea, in January, 1937, the natives brought me a live specimen of *Dactylopsila trivirgata* (hereafter referred to as Dax) which I kept till March 4, 1937. On that date I left New Guinea and gave Dax to Mr. Brass, botanist of the party, who presented it to the Brisbane Museum. I kept Dax in a cage made of wire bird-drying trays, in which I put a section of hollow log for sleeping quarters. During that time I also had several live *Petaurus* in another cage. I have included a few comparative notes on their habits.

¹ 1910, *Ann. Mag. Nat. Hist.*, (8) VI, p. 610.

² Flower, W. H., and Lydekker, R., 1891, 'Introduction to the Study of Mammals,' London, p. 153.

³ Thomas, O., 1910, *Ann. Mag. Nat. Hist.*, (8) VI, p. 610.

⁴ LeSouef, A. S., and Burrell, H., 1928, 'Wild Animals of Australasia,' London, p. 250.

⁵ 1930, *Austr. Zool.*, VI, pp. 169, 170.

GENERAL

Dax was an extremely quiet, strictly nocturnal captive. For the first few days it slept during daylight hours crouched on the floor of its cage. It appeared quite indifferent to its surroundings, but was very sensitive to a jar or tapping on its cage, which caused it to shrink. Later, accustomed to its quarters, it slept curled up on the floor of the cage, and when the section of hollow log was introduced Dax at once slept in that. Dax had not the quick movements and bright-eyed peering attention of *Petaurus*. After dark Dax became active, exploring its cage and, in apparent bursts of energy or rage, moving sticks and its drinking dish, gnawing at the wooden end of its cage and breaking out pieces of its sleeping log with its teeth. In the rays of an electric torch, its eyes gleamed a pale orange-yellow.

The ears were very mobile, usually held about horizontal and occasionally erected. When Dax was resting or sleeping, the ears were frequently closed down against the head, covering the orifices, possibly a modification to protect the orifices from débris in the hollows of trees in which, the natives told me, this animal normally passes the day.

Dax frequently licked both the palms and the backs of its paws. In licking the hind paws it sometimes sat on its rump, supported itself on one fore paw and held up a hind paw in the other fore paw. Only rarely did it groom the rest of the body. Once I saw Dax grooming the fur of its rump with the tongue and teeth. On January 28 I saw it grooming the fur of its body with its hind paws. Partly curled up, Dax combed the fur of one side of its body, up to the middle of its back, top of the head and behind the ear with one hind foot. It really combed the fur with its claws and stopped every now and then to lick them. Once it even reached under the body to comb the opposite thigh. Occasionally the fore paws were used to wipe the sides of the muzzle.

When the animal yawned, as it did occasionally, the tongue protruded to an amazing length. When excited or curious, the nostrils were continually twitched.

CLIMBING AND AGILITY

Dax climbed well on the various branches placed in its cage, descending vertical branches head first (as did *Petaurus*). The big toe of the hind foot is opposable and is opposed in climbing; the thumb is not opposable (the same is true of the *Petaurus*).

Although the tail is bare on the under surface near the tip, I never saw the tail used as a prehensile organ and doubt if it is of much use as

such. Once, however, when Dax was about to tip head first off a small horizontal branch, the tail was curved upward, catching on a branch above, and helped Dax to maintain its balance. *Phalanger*, which uses the tail in a prehensile manner, frequently has it curled like a watch spring when moving slowly about; *Petaurus*, with a non-prehensile tail, sometimes does the same. Dax I did not see do this although the tail was curled up when the animal slept.

It was amazing how supple Dax was. It turned in a hollow log little larger than the diameter of its body. While climbing upside down on the wire mesh of the top of its cage, I saw Dax several times hold on by its hind legs alone, turn its body back through the triangle formed by the hind legs, twisting them quite about before letting go with one, then the other, to drop to the floor of the cage headed in the opposite direction from which it started. One evening Dax came down its vertical hollow log until it could reach the dish of milk on the floor. In this position it drank its fill. Then it picked up a grub from the floor of its cage, held it in its fore paws and devoured it piecemeal while it hung by its hind legs only, its head an inch or so from the floor. *Petaurus* I have seen act in a precisely similar manner. Apparently these animals are so much at home in any position that they do not bother to move to an upright one.

DEFENSE

The natives who brought me Dax told me that it had badly bitten one of them during its capture. When first caged I held a banana toward it. Dax sat up on its haunches, widely spread its forelegs with the wrists turned sharply back, displaying the long fingers to the best advantage and uttering a series of short, grunting squeaks. It looked formidable but did not bite as I touched its nose with the banana. I saw this defense attitude very seldom. Later, when some object was held before its nose, it simply made a single bite at it and then turned away its head.

Though *Petaurus* had a similar defense attitude which was commonly seen, its further actions were different. It watched the intruding object intently, sprang forward a few inches to administer a quick bite, then sprang back again, often giving its squealing chatter.

DRINKING

From the first Dax drank readily and preferred milk to water. It very soon drank from a container held in my hand. It lapped up the fluid with its tongue, making a low sound. Sometimes the nose was no closer than half an inch or more to the surface of the milk, and I found

that Dax could drink quite well from a cup held outside its cage by lapping with its long tongue through the half-inch wire mesh.

The Wassi Kussa River during the dry season is salt as far as Tarara and fresh water is very scarce. If this species needs to drink water regularly, this may be a factor in limiting its distribution in this part of New Guinea.

FOOD

Dax refused banana, mango, bread and butter, jam, peanut butter and raw meat. It ate locusts to a limited extent but sometimes ignored them, however; it ate termites and various soft-bodied wood-boring beetle larvae readily.

This differs from the various records for other members of the genus which are said to eat fruit, leaves and honey as well as insects, while captive specimens in Toronga Park were said to have lived well on a varied diet of condensed milk, biscuits, fruit and lettuce.¹

During the first five weeks I had Dax, I fed it on wood-boring grubs and gave it milk to drink. During the last three weeks it received milk alone (Nestle's Sweetened Condensed) and appeared to thrive. Dax was always slow to find food unless held directly under its nose, but quickly learned to associate forceps with food and to look for food in the same place.

USE OF TEETH

The rodent-like teeth of Dax were apparently not so much cutting as prying and tearing instruments, adapted more to tearing open dead, rotten logs or removing bark, than cutting solid sticks. The lower incisors were thrust into the wood, and using the upper incisors as a fulcrum, the head and body acted as a lever to tear out the piece. Thomas² suspected some such use from an examination of the teeth of a specimen of *Dactylonax*. When first placed in a kerosene case, Dax started tearing at a crack and would have effected its escape in a very short time. Later it prized splinters and bark off sticks placed in its cage. When a splinter of wood came partly free, it was torn off with a sideways swing of the head. In feeding, the teeth were used to remove the layer of timber protecting wood-boring grubs.

FEEDING

The following are examples of its method of feeding. They were observed during the night with the aid of a weakly burning flash-light. This presented some difficulties and demanded some patience as, when

¹ Troughton, L., 1930, *Austr. Zool.*, VI, pp. 169, 170.

² 1910, *Ann. Mag. Nat. Hist.*, (8) VI, p. 610.

the cage was illuminated, Dax frequently became immobile and remained so for some time.

1.—Termites. When I first had Dax and it was tearing splinters off a stick in its cage, I dropped termites one by one just in front of its nose. Dax ate them readily. After eating one it returned to tearing off splinters, noisily licking the surface of the stick, tearing off more splinters and occasionally tapping the stick with its front paws.

I had little success with getting Dax to extract termites from termite-riddled sticks placed in its cage, though once I saw it tear off a piece of bark and pick up a termite from underneath it. It frequently ate stray termites.

The long, extensible tongue and strong teeth all appeared well adapted for termite feeding. The light tapping of the fore paws may also be for startling termites into activity and so locating them or it may be for locating the tunnels of large wood-boring grubs. This tapping, often given when exploring a wood surface, is a quick, sharp tapping of the claws on the wood, producing almost a rustling sound.

2.—Locust: While Dax was very hungry I offered it a locust held in the forceps. Dax at once took it, bit it several times and then dropped it. A few moments later it picked up the locust, held it in its fore paws, pulled off the abdomen and ate it. Later, however, it ignored locusts, even when one lit on its face while Dax was eating a beetle larva.

3.—Small wood-boring beetle larvae: These, a half inch or so long, were eaten eagerly. They were either held up in the paws or held against a stick or the floor while pieces were bitten off and eaten.

4.—Large wood-boring beetle larvae: Some of these were half an inch in diameter and four and a half inches long. They were eagerly eaten though their tough skin caused some difficulty.

Holding the larva in the fore paws, a hole was made, usually in the posterior extremity, with the teeth. Then the contents were extracted by inserting the tongue and rapidly licking, every now and then jabbing into the body with the lower incisors. At times I could see the tongue working inside the partly emptied skin. Dax frequently rapidly licked the outside of the grub. As the skin was emptied it would occasionally be worked into the mouth and then, with the paws, pulled out of the side of the mouth over the molars, apparently to force out the contents of the skin. Working up near the head, Dax sometimes bit the head and frequently extracted the grub's body-contents through additional lateral openings torn in the skin. When Dax was finished there was left the head and part of the thorax attached to an empty tooth-scarred skin.

5.—Small beetle larvae placed in crevices in wood: After feeding Dax a few small grubs from the forceps, I put several into the crevices of a jagged piece of timber in its cage. Most of them were extracted at once by the long tongue, protruded to the fullest extent, licking them from the crevice. A few times the grubs stuck too solidly for that. At first Dax attempted to break open the crevice with its teeth but the wood was too hard. Then the elongated finger was successfully inserted to move them loose.

6.—Large wood-boring beetle larva enclosed in fragile wood: A larva three and one-half inches long was enclosed in thin, fragile splints of wood from the termite-infested floor. After much trouble Dax located the larva, broke a small opening in the wood cover with its incisors and extracted most of the contents of the grub with the tongue and lower incisors, sometimes holding the portion of the partly emptied skin pulled from the hole in one fore paw. It did not attempt to remove the entire grub from the cavity.

7.—Large wood-boring beetle larvae enclosed in solid wood: The "solid blocks" in which these grubs were incased were made by nailing together two pieces of a kerosene case. The cavities for the grubs were made by carving grooves on the sides of the pieces of wood before nailing them together.

One larva (four inches long) was placed in about one-half inch from the entrance of a hole of about its own diameter, opening at the end. The other was protected by about one-quarter inch of wood along the thinnest side and in this I cut a triangular opening about one-quarter inch across.

I watched Dax extract the first larva by fishing into the hole with the long fourth finger. When the end of the grub was brought up it was seized in the mouth, and teeth and tongue proceeded to empty the skin. No attempt was made to extract the whole grub. The part pulled out was taken from the claw by the mouth, and then apparently there was an attempt to work the grub's contents gradually into the mouth as the eating proceeded. Occasionally there was a break in the material being worked into the mouth. The elongated finger was then used like a pole with a hook at the end, tried at various angles, to pull out another strand on which to start. The next morning I found that only the posterior third of the grub had been eaten, the rest evidently having been beyond reach.

I did not see Dax at work on the second grub but on examining the wood in the morning I found only the head and part of the thorax in the

cavity. Most of the grub, including the skin, had been removed without enlarging the small opening provided. Evidently the elongated finger had been used here too.

SUMMARY

Observations were made on a captive *Dactylopsila trivirgata*. It was a quiet, rather stupid creature, nocturnal in habits. It was an agile climber but though the tail is apparently adapted for prehensility, it was not seen to be so used. The big toe is opposable, the thumb not so, but food is held in the fore paws. *Dactylopsila* has a specialized defense attitude. It drank readily and preferred milk to water. If drinking is necessary to this animal that may limit its distribution in south New Guinea.

Its favorite food was wood-boring beetle larvae.

The long tongue was used in removing small grubs from small cavities in wood, and the contents of tough-skinned grubs. The rodent-like teeth were used in breaking open wood in search of grubs; the elongated fourth finger was used to draw out grubs from cavities. This corresponds exactly with the suppositions made by taxonomists regarding the habits of this group of animals.

A habit possibly associated with locating prey encased in wood is a light, quick tapping on a wood surface when examining it.

It is interesting to note the parallel development in structure (and habits?) of this creature and the Aye-aye (*Daubentonia*) of Madagascar.

AMERICAN MUSEUM NOVITATES

Number 958

Published by
THE AMERICAN MUSEUM OF NATURAL HISTORY
New York City

Nov. 2, 1937

NEW ANTHOPHORID BEES FROM CALIFORNIA (HYMENOPTERA)

By P. H. TIMBERLAKE

The types of the new species here described are in the collection of the American Museum, paratypes unless otherwise mentioned in collection of Citrus Experiment Station.

Emphoropsis pallida, new species

The female of *pallida* differs from all our other species in having the clypeus, supraclypeal mark and a small spot on mandibles creamy white. Both sexes also differ from other species in having the pubescence of the abdomen almost entirely appressed.

FEMALE.—Black, the apical margin of tergites 1 to 4 rather broadly rufescent. Tarsi, tibial spurs and tegulae ferruginous. Spot on mandible before the middle (often enlarged to form a streak from inner basal corner to beyond the middle), large portion of clypeus and a transverse supraclypeal mark, sharply pointed at each end, creamy white. Clypeus black around the margin, except dorsally, the black margin being more or less broadened on each side above, sometimes to such an extent that the white mark becomes a thick-limbed T. In one paratype there is a small white spot on each side of face anteriorly, opposite the middle of clypeus. Pubescence grayish white, very dense and rather short on thorax, thinner on the face below the ocellar tuft, but very dense on the cheeks and occipital margin. Sometimes there are a few black hairs intermixed in the ocellar tuft and on the anterior part of the mesoscutum. Disk of first tergite with erect grayish-white hair, which becomes appressed and dense at each side and on apical margin. Following tergites with a fine short appressed whitish pubescence, with a few erect pale hairs intermixed, especially on segments 3 and 4. Base of tergites 2 to 4 with very short black hair. Hair at apex of tergite 5 very dense and whitish, but the hair on each side of the pygidial plate golden. Hair of legs mainly white, the scopal hairs of hind tibiae clear and shiny, but the hair at apex on outer side of front and middle tibiae and on anterior margin of the latter, pale fulvous. Hair on anterior margin of front tibiae, on front tarsi, under side of middle and hind tarsi and inner side of hind tibiae more or less bright ferruginous, becoming especially brilliant on the hind basitarsi. Apical tuft on hind basitarsus fuscous, blacker at tip. Clypeus somewhat shiny with close shallow punctures. Hairy part of face and vertex very finely and densely punctured, but the nude area on each side of ocellar area impunctate. Mesoscutum dull, densely and finely punctured, the punctures becoming sparse and the surface distinctly tessellate in a small area on the posterior middle of disk. Scutellum with a similar sculpture, with the punctures exceedingly dense and less distinct. Antennae black, the third joint about equalling the three following joints combined. Wings slightly

smoky, subhyaline, the veins black. Length, 13 to 15 mm.; anterior wing, 10.5 to 11 mm.

MALE.—Similar, but basitarsi of all legs blackish, and apex of tergites broadly whitish subhyaline, preceded by a narrow rufescent band. Mandibles on outer side, except apex, clypeus except a black dot on each side above and a dot on each suture opposite the discal dots, a rather broad supraclypeal mark widened in middle, large lateral marks, concave above and reaching along orbits slightly above the level of antennae, and scape broadly beneath, creamy white. Pubescence, except for the usual sexual differences, as in the female, but hair on sides of last tergites and at apex of front and middle tibiae whitish. Basal half of tergites 2 to 4 and basal margin of tergites 5 and 6 with fine appressed black hair, the pale hair being mostly confined to the pallescent apical border, the abdomen thus much more distinctly banded than in the female. Rarely there are a few brownish hairs intermixed on vertex and mesoscutum. Clypeus usually smooth and shining, with rather sparse fine punctures. Sculpture otherwise as in the female. Pygidial area of tergite 7 broadly truncate at apex, its disk rather shiny, finely punctured on each side. Antennae short, the third joint nearly as long as joint 4 plus 5. Length, 11 to 14 mm., anterior wing, 9 to 10 mm.

Holotype female and allotype collected on *Larrea divaricata*, three miles east of Edom, Riverside County, California, March 8, 1936 (Timberlake). The following paratypes have also been studied: 12 ♂, 2 ♀, from type locality (Timberlake); 6 ♂, from type locality (Linsley) in Linsley collection; 9 ♂, 2 ♀, from type locality (F. R. Platt), in Platt collection; 2 ♀, 2 miles south of Oasis, Riverside County, on *Larrea*, March 7, (Timberlake and Linsley); 1 ♀, 7 miles north of Palm Springs, on *Larrea*, March 17; 2 ♂, Palm Springs, on *Phacelia distans* and *Larrea*, March 21 and 26; 1 ♂, 4½ miles northwest of Indio, on *Larrea*, March 8; 1 ♀, Edom, on *Larrea*, March 28 (Linsley) in Linsley collection; 1 ♂, Borego Valley, San Diego County, on *Chaenactis stevioides*, March 26; 1 ♂, 1 ♀, Andrade, Imperial County, ♀ found dead on ground (Franklin Woodward), ♂ on *Larrea*, March 6 (Cockerell), in Cockerell collection; 5 ♂, Needles, San Bernardino County, Dec. 21, 1921 (J. A. Kusche), in collection of California Academy of Sciences; and 2 ♂, Buckeye, Maricopa County, Arizona, on *Lycium torreyi*, March 28.

Emphoropsis dammersi, new species

This is similar to *E. depressa* (Fowler), but it has the light hair of abdomen erect instead of depressed, the face markings of the male dark yellow instead of white, and the female usually has a small yellow spot (entirely lacking in *depressa*) on each side of the face between the clypeus and the eye margin.

FEMALE.—Black, the femora more or less rufescent. Tibial spurs pale ferruginous, that of the middle tibia strongly curved at apex. A dot at inner basal corner of mandibles, small spot (rarely absent) on anterior sides of face between clypeus

and eye margin, and sometimes a supraclypeal line, yellow. Hair of head and thorax pale fulvo-ochreous or tawny ochreous, becoming white on cheeks, occipital margin, lower part of pleura, sternum and propodeum, and strongly intermixed with black hairs on face, vertex, mesonotum and upper part of pleura. Hair of abdomen erect, long on disk of first tergite, short on following segments, cinereous or a little tinged with tawny and strongly intermixed with black hairs. On tergite 1 the black hairs are mostly confined to apical margin. Hair at apex of tergite 3 and on disk of 4 longer, becoming depressed at apex of 4, that in the middle of apical margin of 4 cinereous, not mixed with black, although there are many black hairs on each side. Dense hair at apex of tergite 5 black, overlaid with gray hairs proceeding from the basal part of segment. Hair at each side of pygidium black. Hair of venter pale ochreous or whitish, forming a long apical fringe on each segment, but hair at apex of segment 6 and some hair on the middle of the disk of 5, preceding the fringe, black. Hair of legs whitish, or more or less tinged with ochreous, with much fuscous or black hair on outer side of middle tibiae and on outer margin of hind tibiae except at apex. The short apical tuft of hind femora and the usual apical tuft of hind basitarsi also black. Hair on inner side of tarsi ferruginous, that of middle and hind basitarsi very bright, but margined with black hair on each side of hind pair. Clypeus dullish, densely and shallowly punctured. Sides of face and ocellar region finely and densely punctured. Mesoscutum finely and densely punctured except in two small areas, one on each side of median line posteriorly, where the punctures are sparse and the surface between the punctures delicately tessillate and rather shiny. Scutellum similarly sculptured. Antennae black, the 3rd joint a little longer than the following three joints combined. Tegulae black, shining, very minutely punctured. Wings rather strongly tinged with fuscous, the veins black. Length, 13.5 to 16 mm., anterior wing, 11 to 11.5 mm.

MALE.—Similar, but legs black, the tibial spurs pale ferruginous. Large mark on mandibles, clypeus, supraclypeal mark widened in middle, lateral marks concave above and reaching on the orbits to level of the middle of antennal sockets and scape broadly beneath, deep yellow, almost orange-yellow. Anterior margin of clypeus narrowly brown and a small triangular mark, subtended by the suture on each side above, black. Pubescence much as in the female, with much black hair intermixed on face, vertex, mesonotum, upper part of pleura and tergum. Hair of abdomen, especially the black hairs, somewhat longer than in the female. Seventh tergite broadly truncate at apex, its disk densely covered with appressed golden pubescence, changing to ferruginous and then to fuscous at apex. Hair of venter entirely light. Hair of legs light, except for a few black hairs on front and middle femora and tibiae. Hair on inner side of tarsi bright ferruginous. Clypeus a little dullish, finely and obscurely punctured. Antennae reaching to apex of scutellum, the third joint barely longer than the fourth. Length, 12 to 15 mm., anterior wing, 10 to 10.8 mm.

Holotype female and allotype collected at flowers of *Arctostaphylos glauca*, Cajon Canyon, San Bernardino County, California, at elevation of about 3500 feet, Feb. 28, 1936 (Timberlake).

The following paratypes unless otherwise mentioned are in the collection of the Citrus Experiment Station: 44 ♂, 14 ♀ taken with the types; 27 ♂, 13 ♀ from the type locality, Feb. 25 and 28 (F. R. Platt),

in the Platt collection; 1 ♀ taken at the type locality in Cajon Canyon, at flowers of manzanita, March 31, 1933 (C. M. Dammers); 2 ♀, taken on damp ground, Keen Camp, San Jacinto Mountains, Riverside County, April 2, 1933 (C. M. Dammers); 1 ♀, Lone Pine Canyon, San Bernardino County, in March (C. M. Dammers), in the Dammers collection; and 6 ♀, 8 miles south of Temecula, Riverside County, on *Ceanothus* (collecting pollen), March 5, 1936 (F. R. Platt), in Platt collection.

This species is named in honor of Commander C. M. Dammers, who brought me the first specimens seen of this fine species.

Anthophora cockerelli, new species

A *Micranthophora* most closely allied to *A. flexipes* Cresson and *A. albata* Cresson. The male may be distinguished by the very long, slender, simple legs, by the face below antennae entirely yellow and almost nude, by the yellow scape and pale ferruginous flagellum. The female also has the face below antennae nearly all yellow and the scape yellow in front, by which characters it may be distinguished from all our other species.

MALE.—Black. Mandibles except the reddish apical teeth, labrum except two hyaline dots at base, entire face below antennae, and scape except above, rather pale yellow or almost cream color. Second and third joints of antennae black, the rest of flagellum pale ferruginous, slightly dusky above toward the base and at the articulations. Legs entirely dark, except base of claws and sometimes apex of last joint of tarsi more or less, ferruginous. Smooth depressed apical margin of tergites inconspicuously subtestaceous. Sixth ventrite brownish testaceous. Tegulae pale amber color. Wings clear hyaline. Basal half of venation ferruginous, the veins of the apical cells more brownish. Eyes yellowish green. Hair of head and thorax fulvo-ochraceous, rather short and dense, becoming paler and depressed on frons. Face below antennae almost nude. First three tergites with short appressed fulvo-ochraceous pubescence, longer on the first segment and becoming erect toward the base of that segment. Following tergites with fine fuscous or black hair, sometimes with more or less light hair intermixed, the sides of tergite 4 showing considerable light hair in one specimen. Venter almost nude, except the fifth segment which has a rather dense, short and blackish pubescence. Front and middle legs without long hairs except a very thin fringe on front tarsi behind. Front femora entirely nude and middle pair mostly so, but with a streak of brownish ochraceous pile on posterior margin and on basal half of anterior surface. Exterior surface of all the tibiae, under side of hind coxae and an area on sternum just in front of hind coxae, with dense appressed silvery white hair. Hind trochanters with similar or sometimes with brownish hair. Under side of hind femora and tibiae fringed with long dark brown or blackish hair, which is denser on the tibiae. Tarsi with black pubescence, which is long and more brownish on inner side of hind basitarsi. Front basitarsi with thin whitish appressed pubescence on outer side. Middle basitarsi with longer, erect, fine bristle-like hairs intermixed with the black on outer side.

Eyes large, strongly divergent above. Clypeus prominent and very convex for this group. Labrum trilobate at apex. Mandibles strongly and sharply bidentate

the inner tooth not much less than half as large as the other and divergent. Antennae short, the third joint only slightly longer than joint 4 plus 5, and the joints of flagellum except the last no longer than wide. Seventh tergite weakly and obtusely angulate on each side at base, and with the apical middle slightly produced, broadly truncate and weakly notched medially, but apex not distinctly bilobate. Fifth ventrite very large and almost concealing the sixth, the latter broadly emarginate at apex.

Front and middle legs, including femora, very slender, the middle pair extremely long. Front tarsi not distorted, the basitarsus almost as long as tibia. Middle tarsi very long and slender, the basitarsus longer than the tibia, slightly curved and about equal to following tarsal joints combined. Hind legs comparatively short and about normal for group. Spurs of middle and hind tibiae small and normal (strongly enlarged and modified in *flexipes*). Venation as in *flexipes*. Nude part of face microscopically shagreened and somewhat dullish, not distinctly punctured. Labrum shining and with sparse indistinct punctures. Vertex behind ocelli densely and finely punctured, the area between the ocelli sparsely punctured. Concave space between lateral ocelli and eyes shining and microscopically punctulate. Thorax closely punctured like the vertex, mesoscutum more densely so, but with two oval impunctate shining spaces on the posterior middle of disk. Length, about 9 mm., anterior wing, 6.9 mm.

FEMALE.—Similar to male except for usual sexual characters. Face markings rather bright yellow, not quite covering space below antennae, the black descending along orbits nearly to level of middle of clypeus. Lateral marks oblique, not notched above. Supraclypeal mark angulately widened in middle. Flagellum darker ferruginous, more dusky above, but color of antennae otherwise as in the male. Pygidium reddish. Pubescence paler than in male, ochraceous above on head and thorax, and pale ochraceous or whitish on face, cheeks, pleura and legs. Tergites 1 to 5 very densely covered with fine appressed pale ochraceous or creamy pubescence, that on the base of 1 erect. Base of segments neither nude nor blackish. Tuft of longer hair on apex of 5 obtusely triangular, deeper ochraceous or sometimes brownish. Hair on inner side of basitarsi dark brownish ferruginous, sometimes darker or fuscous on margins of hind pair. Mandibles stouter, the teeth larger and blunt. Labrum truncate at apex, its disk somewhat rugosely punctured. Clypeus more shining than in the male, finely, closely but not very distinctly punctured. Area on each side of ocelli much more distinctly punctulate and less shining. Impunctate areas on disk of mesoscutum small. Flagellum less stout than in the male, the middle joints as long as wide. Third joint of antennae as long as the next three combined. Pygidium rather wide at base, triangular, the apex narrowly rounded, its disk with a median ridge. Length, 8.5 to 9.5 mm., anterior wing, 6.8 to 7 mm.

Described from 3 males and 14 females, at flowers of *Cleomella obtusifolia*, Mohave Desert, California (Timberlake), collected as follows: 1 ♂, 8 ♀ (holotype male and paratypes), Barstow, September 12, 1924; 1 ♀ (allotype), Barstow, October 6, 1928; 1 ♀ (paratype), Oro Grande, October 7, 1928; 1 ♂ (paratype), Black's Ranch, north of Barstow, October 1, 1928; 1 ♂ (paratype), Hodge, September 14, 1935; and 4 ♀ (paratypes), Barstow, September 14, 1935.

I take pleasure in dedicating this remarkably fine species to T. D. A. Cockerell.

Anthophora abroniae, new species

The male of *abroniae* is distinguished from other described species of *Micranthophora* in having no lateral teeth on the seventh tergite, the apical teeth small and acute, the mandibles slender and simple, and the antennae entirely dark. The female is similar to *A. albata* Cresson (although the male is very different) but has the flagellum at most only obscurely reddish beneath and the mark on the clypeus triangular and pointed above. In *albata* the white mark of clypeus is a broad transverse band covering nearly the anterior half, and more or less triangularly produced above in middle to dorsal margin. It also has a supraclypeal mark, absent in *abroniae*.

MALE.—Black, with the mandibles except reddish tips, labrum except two large testaceous hyaline spots at base, and a narrow band on anterior part of clypeus, extending no farther laterad than sides of labrum and normally concealed by hair, yellowish white. Antennae black, the flagellum obscurely reddish beneath. Small joints of tarsi and apical teeth of abdomen ferruginous. Tegulae pale amber to very pale testaceous hyaline. Wings clear hyaline, the veins piceous, becoming progressively more or less ferruginous toward base of wing, the costal vein entirely ferruginous. Spurs very pale testaceous. Apical margin of tergites 1 to 6 testaceous hyaline. Eyes greenish gray when dry. Pubescence rather abundant, moderately long, silky and white, being very dense on face and concealing the surface, and somewhat shorter on thorax. Disk of mesoscutum and scutellum well exposed. Abdomen with short fine appressed and moderately dense grayish or slightly ochraceous pubescence, covering the surface of the tergum almost uniformly, and becoming longer, sparser and erect on base of first tergite. Venter with very fine appressed pale inconspicuous pubescence. Hair of legs white, very dense and appressed on outer side of tibiae and basitarsi. Front and middle femora and tibiae fringed behind with long white hair, the front tarsi with a shorter sparser fringe. Hair on under side of hind femora long and white, but that on under side of hind tibiae blackish. Tarsi beneath with bright ferruginous hair. Hind basitarsi beside the short white hair on outer surface have long white hairs on the anterior margin.

Mandibles slender and acute at apex, without an inner tooth. Labrum broadly rounded at apex, truncate in middle. Tongue very long, reaching when fully extended beyond the apex of abdomen. Antennae short, the third joint a little longer than 4 plus 5, and the middle joints of flagellum about as long as thick. Face rather wide, the eyes divergent above, and facial quadrangle about as long as width at vertex. Seventh tergite with a median carina and two small acute apical teeth, separated by a rounded notch. Latero-basal teeth absent. Sixth ventrite with a small rounded emargination in middle of apical margin. Legs ordinary. Face below antennae very finely and closely punctured, but white band on clypeus smooth and impunctate. Labrum shining, very obscurely and minutely punctured. Vertex behind ocelli and the thorax rather closely and finely punctured. Concave space between lateral ocelli and eyes minutely and closely punctulate. Mesoscutum with two oval impunctate spaces on middle of posterior part of disk. Length, 7 to 8 mm., anterior wing, 5 to 5.5 mm.

FEMALE.—Similar to male, but larger and more robust. Black, the mandibles except piceous apex, labrum except two large testaceous pustules at base, and a triangular mark on clypeus, yellowish white. Clypeal mark reaching outward no farther than sides of labrum, nearly equilateral in shape, with the sides distinctly concave. Tarsi, antennae and wings colored as in male. Tegulae clear amber color. Pubescence ochraceous on vertex and thorax above, sometimes slightly intermixed with dusky or blackish hairs on mesoscutum and scutellum, but these darker hairs are never conspicuous and are entirely absent in type. Face, lower part of cheeks, pleura and legs with whiter hair. Hair dense between and around antennae and on sides of face, but the pale mark on clypeus is fully exposed. Tergum of abdomen densely covered with fine appressed pale ochraceous or creamy pubescence, but base of first tergite with long erect hair. Tuft of hair at apex of tergite 5 black and rather large. Front femora with a thin whitish fringe beneath. Hind tibiae with some blackish hair beneath, especially toward apex. Tarsi beneath with rather bright ferruginous hair, but that on hind basitarsi margined with blackish, especially on anterior side. Fan of hair at apex of hind basitarsi blackish. Mandibles rather slender, with a small inner tooth. Tongue rather long, the blades of the maxillae being long, slender and hairy. When in retracted position the maxillae reach to middle coxae. Third antennal joint as long as the next three joints combined. Basal vein received behind the nervulus. First recurrent received by second submarginal cell near beginning of its last third. Pygidium reddish, rather acute at apex and with a median ridge. Clypeus finely, densely punctured, except that the pale mark is nearly impunctate. Labrum subrugose, not distinctly punctured. Sculpture otherwise much as in the male. Length, 8 to 9 mm.; anterior wing 5.9 to 6.1 mm.

Described from 30 ♂, 10 ♀ (holotype male, allotype and paratypes) collected at flowers *Abronia villosa*, Palm Springs, California, at edge of town, April 9 and 10, 1932 (Timberlake), and the following paratypes: 3 ♂, 13 ♀, Borego Valley, San Diego County, March 26, 1933 (Timberlake), males flying over ground, females entering or leaving nests; 2 ♂, 1 ♀, Edom, Riverside County, on *Abronia villosa*, March 28 and April 7, 1936 (Timberlake); 2 ♀, Coachella Valley, Riverside County, May 29, 1935 (Margaret L. Cook); 5 ♂, 4 ♀, near Buckeye, Gila River, Maricopa County, Arizona, on *Heliotropium curassavicum*, March 29, 1934 (Timberlake).

At Palm Springs the females were seen entering their burrows in the sand near the *Abronia* flowers; at Borego the bees were nesting in a community in rather hard-packed soil. The long tongue of this bee seems to be especially adapted to the long tubular flowers of *Abronia*.

Anthophora salazariae, new species

This species is allied to *A. abroniae* Timberlake, and the male may be distinguished by having the white fringe of hair on under side of femora shorter (about as long as thickness of femora in *salazariae* and twice as long in *abroniae*), the antennae longer, with middle joints of flagellum longer than thick, and the three

apical tergites more thinly pubescent and appearing darker than preceding segments. The female differs from *A. albata* Cresson in having the yellow clypeal band narrow, but produced above, the supraclypeal mark absent, and hair on under side of tarsi bright ferruginous. From the female of *abroniae* it differs in having the tongue shorter, fifth tergite not densely covered with pale pubescence, clypeal mark yellow, not triangular, etc.

MALE.—Black, with the mandibles except reddish tips, labrum in large part, and a short narrow band on anterior margin of clypeus, rather pale yellow. Lateral reflexed margins of labrum piceous, and the two pustules at base brownish testaceous. Flagellum brownish beneath. Small joints of tarsi and apical teeth of abdomen ferruginous. Tegulae testaceous hyaline. Depressed area at apex of tergites 1 to 6 whitish hyaline. Wings clear hyaline. Veins brownish piceous, the subcosta black, but it and other veins at extreme base of wing and approximately the basal half of costal vein, ferruginous. Eyes green. Pubescence white and silky. It is rather worn in type but apparently does not differ greatly from *abroniae*, except that the face is much less densely covered and the hair on tergites 5 to 7 is fine, appressed, but not at all feltlike, so that the surface is well exposed and appears blacker than that of preceding segments. Also the little fan of hairs surrounding the anterior ocellus is extremely thin and a large triangular area in front of the ocellus is well exposed. Hair of legs white, but light ferruginous on under side of tarsi. Unlike *abroniae*, the tibiae are not fringed with long hairs and the fringe on the femora is much shorter and sparser. Front tarsi with a few long white hairs on outer side. Hair on anterior margin of outer side of hind basitarsi not long and dense as in *abroniae*. Structurally much like *abroniae* except as follows: Eyes less strongly divergent above. Clypeus less prominent, somewhat depressed. Labrum more truncate at apex. Tongue considerably shorter. Maxillary blades rather wide at base, but tapering, with the apical fourth very narrow. Antennae longer, the joints of flagellum (except fourth antennal joint) distinctly longer than wide. Joint 3 somewhat shorter than 4 plus 5. Apical teeth of seventh tergite blunt at apex, distinctly larger and broader than in *abroniae*, but still very small in comparison with most other species. Sculpture about as in *abroniae*, except that the labrum is slightly roughened and obscurely punctured. The impunctate areas on disk of mesoscutum barely larger. Length, about 7.5 mm., anterior wing (frayed at end), about 5.4 mm.

FEMALE.—Much like the female of *abroniae* but differing as follows: Face markings somewhat deeper yellow. Anterior and lateral margins of labrum brownish or piceous. Clypeal mark in form of a narrow band, extending outward as far as sides of labrum, somewhat widened in middle but not produced above. Flagellum brownish beneath. Pubescence white, or grayish white, not at all tinted with ochraceous, the hair of mesonotum inconspicuously intermixed or tipped with fuscous. Hair on inner side of tarsi clear ferruginous, not margined with darker hair on hind basitarsi. Hair of face dense at sides and on supraclypeal area, but the black part of clypeus thinly covered with short appressed hair. Tergites 1 to 4 densely covered with whitish pubescence, but 5 with much thinner light pubescence and appearing black in contrast with preceding segments. Labrum more rugose than in *abroniae* and with a scalelike transverse carina in the middle a short distance from apex. Clypeus closely and finely punctured except on the yellow mark. The shining impunctate areas on mesoscutum somewhat larger than in *abroniae*. Tongue

shorter. Maxillary blades not hairy, wide at base and tapering to apex, and when in retracted position reaching to front coxae. Antennae somewhat longer and stouter, the third joint longer than 4 plus 5, but not equalling the next three joints combined. Length, 8 to 9 mm., anterior wing, 6.3 to 6.5 mm.

Described from 1 ♂ (holotype), at flowers of *Lupinus odoratus*, Mohave Desert, about 8 miles southwest of Victorville, California, May 22, 1932 (Timberlake); 1 ♀ (paratype), Clark Mountain, Mohave Desert, May 17, 1935 (C. M. Dammers); 2 ♀ (paratypes), Kramer Junction, Mohave Desert, May 1, 1936 (C. M. Dammers); 2 ♀ (allotype and paratype) at flowers of *Salazaria mexicana*, about 10 miles southwest of Victorville, May 17, 1930 (Timberlake), and 1 ♀ (paratype) at flowers of *Langloisia matthewsii*, at the same time and place as the two preceding specimens.

This bee is evidently not restricted to any one flower, but I have chosen to associate it by name with one of the commonest and most characteristic shrubby plants of the Mohave Desert, the flowers of which it is sure to frequent more or less regularly. It is evidently most closely allied to *A. columbariae* Timberlake and Cockerell, of which it may prove to be a subspecies. The female differs from *columbariae* in having clypeus closely, finely and distinctly punctured, flagellum brown beneath, maxillary blades ferruginous, instead of dilute fuscous, less tapering and blunter at apex (tapering to an acute point in *columbariae*), hair of vertex and mesonotum with little intermixture of dark hairs (*columbariae* from type locality having a strong intermixture of black hairs), fifth tergite less strongly contrasting with preceding segments, hair of under side of tarsi clear ferruginous, not margined with black on hind basitarsi, fan of hairs at apex of hind basitarsi more or less ferruginous, instead of black. The male differs in having hair of last three tergites light instead of black, but allowing the black integument to show plainly, no intermixture of dark hairs on vertex and mesonotum, small joints of tarsi clear ferruginous, hair on under side of tarsi clearer ferruginous, flagellum reddish brown beneath, blades of maxillae more ferruginous, wings clearer hyaline, mandibles with inner tooth weakly developed (short and small, but separated from shaft by a distinct notch in *columbariae*).

A male from Deep Creek, Mohave Desert, May 5, 1936, at flowers of *Eriodictyon*, although classified as *columbariae* might be referred to either species. It has flagellum brown beneath, the notch separating inner tooth of mandible very weak, vertex and mesonotum with a few dark hairs intermixed, and hair of last three tergites mainly black. It

has the clypeus entirely black (in *columbariae* the pale clypeal band may be present or absent). This specimen is probably an indication that the two species intergrade, yet a female from Deep Creek is a typical *columbariae*.

Anthophora mortuaria, new species

Like the two preceding species (and also *A. columbariae* Timberlake and Cockerell) this species belongs to that section of *Micranthophora* typified by *A. pachyodonta* Cockerell. *Mortuaria* bears about the same relationship to *pachyodonta* that *salariae* does to *columbariae*. Both *pachyodonta* and *mortuaria* are distinguished from the other species here described by having the two teeth at apex of male abdomen comparatively large and broad, and the inner tooth of the mandible strongly developed. The male of *mortuaria* is distinguished from *pachyodonta* by having meso-scutum densely punctured with two small impunctate areas on middle of disk (densely punctured all over in *pachyodonta*), face markings yellowish white instead of bright yellow, pubescence ochraceous to fulvo-ochraceous instead of white, and scape black only above. The female differs from *A. xanthochlora* Cockerell (which after all must be considered the female of *pachyodonta*), in having the face markings whitish, the scape entirely pale beneath, the pubescence more richly colored, and the triangular patch of hair on the fifth tergite black instead of pale fulvous.

MALE.—Black, with mandibles except piceous tips, labrum except small hyaline spot on each side of base, broad band on clypeus, and scape broadly beneath, pale yellowish white. Pale band on clypeus reaching to eyes and broadly arched above, where in the middle it reaches slightly above the center of clypeus. A slender median streak on dorsal part of clypeus and a narrow transverse supraclypeal mark, white but normally concealed by the dense hair. Flagellum obscurely reddish beneath. Tarsi dark, the small joints obscurely dark ferruginous. Apical lobes of seventh tergite ferruginous. Tegulae amber color. Wings clear hyaline, the veins piceous, the costal vein ferruginous on basal half. Tibial spurs pale testaceous. Apical margin of tergites 1 to 6 testaceous hyaline. Pubescence silky, abundant, ochraceous, varying to pale ochraceous, becoming white on face, cheeks and occiput, or sometimes becoming a rich ochraceous brown on all parts except the face. Hair of face very dense and more or less white. Anterior part of clypeus nude, but overhung and more or less concealed by the facial hair. Vertex and disk of mesoscutum with sparser hair than other parts, the surface well exposed. Disk of tergites 1 to 6 entirely covered with fine appressed feltlike pubescence, the base of 1 with the usual longer erect hair. Hair of legs concolorous with that of body, very dense and appressed on outer side of tibiae and basitarsi. Femora and front tibiae fringed behind with moderately long and dense hair. Middle tibiae with a sparse short fringe beneath. Hind tibiae with abundant long hair beneath, becoming ferruginous at apex. Tarsi beneath with bright ferruginous hair.

Mandibles strongly bidentate, the inner tooth shorter and broader than apical tooth. Both teeth seem longer and less widened than in *pachyodonta*. Labrum truncate at apex, with a small rounded median lobe, and with the apical corners rounded. Antennae rather long for *Micranthophora*. Flagellum stout, joints 5 to 13 distinctly longer than wide. Third antennal joint about equal to 4 plus 5. Apical joint slightly widened, truncate and beveled beneath at apex. Maxillary blades in repose reaching to front coxae. Face moderately narrow, but eyes strongly divergent

above. Facial quadrangle somewhat longer than width at vertex. Seventh tergite obtusely angulate on each side at base, the apical lobes about twice as long as wide, bluntly rounded at apex. Emargination between lobes about twice as wide as either lobe. Disk of seventh tergite with a short median carina, not reaching to base of lobes. Sixth ventrite strongly depressed on apical margin, deeply emarginate in middle, the weltlike boundary of the depression distinct and conforming to the shape of the emargination. Legs ordinary. Labrum shining, sparsely punctured. Face, including clypeus, finely and closely punctured, but anterior part of white band polished and impunctate. Ocellar region and vertex behind the ocelli densely punctured, but with two impunctate shining lines forming a right angle, pointed forward, between the posterior ocelli. Concave area between ocelli and eyes closely punctulate. Thorax closely punctured, the two impunctate areas on middle of mesoscutum rather small. Length, 8 to 9 mm., anterior wing, 6.5 to 6.75 mm.

FEMALE.—Similar to male. Black, with large mark on mandibles, labrum except two subhyaline pustules at base, most of clypeus, minute lateral mark between clypeus and anterior end of eyes, transverse supraclypeal mark and scape in front, creamy white. Clypeus with a black mark on each side above, rounded beneath, so that more than anterior half of clypeus and a broad median extension above is pale. Anterior margin of clypeus very narrowly testaceous brown. Pygidial plate castaneous. Flagellum black. Other parts colored about as in male. Pubescence more or less ochraceous on vertex, notum of thorax and abdomen, and whiter on other parts. Face hairy at sides and on the frons, but the white markings left well exposed. Mesonotum with short erect fairly dense pubescence. Tergum of abdomen densely covered with fine short appressed pubescence, but base of first tergite with erect, rather short hair. Triangular hair area on fifth tergite fuscous or blackish. Hair of legs whitish or very pale ochraceous. Front femora with a long white fringe beneath. Front tarsi fringed behind with long hairs, but not densely. Tarsi beneath with brownish ferruginous hair, appearing darker or lighter in different lights. Labrum rounded in front, subrugose, finely punctured. Face below antennae gently convex, the clypeus not prominent. Clypeus with moderately close, irregularly spaced punctures. Facial quadrangle almost as wide at vertex as long. Third antennal joint about as long as the next three combined. Joints of flagellum mostly about as long as wide. Mesonotum densely punctured, subopaque, except two small shining impunctate areas on disk of scutum. Pygidium acute at apex, the disk medially with a rounded longitudinal crest, higher and wider at the middle of the plate. Length, 8 to 9 mm., anterior wing, 6.1 to 6.6 mm.

Described from 9 ♂, 1 ♀ (holotype male, allotype and paratypes) at flowers of *Pluchea sericea*, Furnace Creek, Death Valley, California, May 1, 1927 (Timberlake); 4 ♂, 2 ♀ (paratypes), Coachella, Riverside County, May 13, 1917 (Van Duzee), in collection of California Academy of Sciences; and 14 ♀ (paratypes), on *Pluchea sericea*, Westmoreland, Imperial County, May 31, 1930 (Timberlake).

Anthophora emarginata, new species

A. emarginata is similar to *A. rhodothorax* Michener, which I have not seen but differs from the description of the latter in having the yellow band of clypeus usually produced upward in middle to dorsal margin, vertex and mesonotum with more or

less black hair in both sexes, tuft of hair at apex of fifth tergite in female small and usually concolorous, apical margin of tergites in male testaceous instead of ferruginous or fulvous, and the size somewhat smaller. The pubescence in *emarginata* varies from ferruginous to ochraceous and grayish white.

MALE.—Black, the mandibles except reddish piceous tips, labrum, broad anterior band on clypeus, transverse supraclypeal mark and under side of scape, yellow. Clypeal band reaching to eye margins and sometimes with a median spur to dorsal margin. Flagellum dark. Small joints of tarsi ferruginous, the claws reddish piceous except at base. Tibial spurs testaceous. Tegulae piceous, often more or less testaceous on outer margin. Wings dusky hyaline, the veins black. Apical margin of tergites, especially 3 to 6, testaceous. Apical teeth of seventh tergite testaceous at apex. Eyes green. Pubescence dark ferruginous, becoming ochraceous on cheeks, face and under side of thorax, but often varying to ochraceous or grayish white. Vertex and middle of mesonotum with more or less black hairs, sometimes absent on vertex. Head and thorax with the hair moderately long, not very dense, becoming thinner and short on disk of mesoscutum, where the surface is well exposed. Pubescence of abdomen appressed, feltlike, concealing the surface, but longer and erect on base of first tergite. Base of second tergite with a broad black band at base, and next four tergites with a narrow black band (more or less concealed when segments are retracted), where the hair is very short, black, not feltlike. Venter with extremely fine appressed sericeous pubescence, much longer and denser on segments 4 and 5. Hair of legs concolorous with that of under side of thorax, varying from dark ochraceous to grayish white. Outer side of tibiae densely covered with appressed hair. Hair on under side of tarsi bright ferruginous.

Inner tooth of mandible about as broad and blunt as the apical tooth. Clypeus moderately convex, shining, minutely punctured, the yellow part more sparsely and obscurely punctured. Eyes larger and face distinctly narrower than in *A. curta* Provancher. Facial quadrangle nearly twice as long as width at clypeus. Third antennal joint slightly longer than next two joints combined. Fourth joint much shorter than fifth. Vertex shining, minutely and densely punctulate on each side next to eyes, impunctate in concave area on outer side of lateral ocelli, and more coarsely punctured in a triangular area between and behind ocelli. Mesonotum shining, closely and finely punctured, the punctures usually becoming a little sparser each side of median line a little behind the center of scutum. Apical teeth of seventh tergite slightly divergent, nearly twice as long as wide, broad and blunt at apex, and separated by a triangular notch hardly wider than width of either tooth. Lateral teeth small and black. Basal vein received a little behind nervulus. First recurrent vein received by the second submarginal cell at the middle. Legs ordinary. Length, 7 to 8 mm., anterior wing, 5.5 to 6 mm.

FEMALE.—Similar to male except in usual sexual characters. Face marking similar, except scape entirely black. Tegulae testaceous brown. Pubescence similar, but black hairs of vertex and mesonotum much more abundant. Abdomen covered with fine feltlike hair, except a subapical band on tergite 1 and a basal band on tergite 2, which appear black. Sometimes a narrow black band appears on base of tergites 3 and 4, when segments are extended. Triangular brush of hair at apex of tergite 5 usually concolorous, but varying to ferruginous brown or even black. Hair of legs ochraceous, or more or less ferruginous in brighter colored specimens. Hair on under side of tarsi ferruginous. Fan of hairs at apex of hind basitarsi fer-

ruginous, varying to fuscous, or tipped with fuscous. Third antennal joint almost equalling the next three combined. Fourth joint a little shorter than fifth. Punctuation of clypeus and vertex considerably coarser and sparser than in male, but that of mesonotum nearly the same. Apical tooth of mandible about twice as broad as inner tooth. Pygidium moderately narrow, acute at apex, ridged down the middle, and dark reddish to piceous in color. Length, 7.5 to 9.5 mm., anterior wing, 5.3 to 6.1 mm.

Described from 13 ♂, 73 ♀ (holotype male, allotype and paratypes), Riverside, California, the males collected between August 26 and September 24 at flowers of *Gutierrezia californica* and *Corethrogyne filaginifolia* var. *bernardina*, the females at the same flowers and *Ericameria palmeri*, between September 10 and November 14 (Timberlake); and 3 ♀ (paratypes), Claremont, California (Baker).

The type and allotype represent the brightly colored end of the series, which is considerably outnumbered by the grayish specimens.

Anthophora californica albomarginata, new subspecies

Similar to *A. californica* Cresson and *A. californica texana* Cresson in both sexes, but differing in having no black hair on vertex and mesonotum, the white bands of abdomen considerably broader, and the disk of the tergites with thin pale subappressed pubescence.

FEMALE.—Black, the mandibles reddish in middle, the basal part of the reddish area suffused with yellow. Flagellum obscurely dark reddish beneath. Tegulae, small joints of tarsi and tibial spurs ferruginous. Wings nearly clear hyaline, the veins piceous, becoming ferruginous at wing base. Apical tegumentary band on tergites 1 to 4 broad, chalky white, that on 2 to 4 narrowed sublaterally in front on each side. Pubescence of vertex and mesonotum fulvo-ochraceous, rarely with a trace of black hairs intermixed. Pubescence of other parts of body white or whitish. Disk of tergites 2 to 4 with thin short subappressed pale hair, more or less overrunning the white bands, but bases of these segments with inconspicuous black hair. Otherwise mostly as in *californica*, which has much black hair intermixed on vertex and mesonotum, and disk of tergites 2 to 4 with short erect black hair. Length, 11 to 13 mm., anterior wing, 8 to 9 mm.

MALE.—Similar to the female, except in sexual characters, and structurally like *californica* and *californica texana*. It differs from both *californica* and *texana* in having the face markings pale yellow, the white band at apex of tergites 1 to 6 considerably broader and more sinuate in front, and hair of abdomen mainly whitish and subappressed. (Hair on disk of tergites in *californica* slightly longer, erect and black; in *texana* subappressed and black; but both have hair on first and last segments light, and more or less light hair along lateral margins of abdomen.) Vertex and mesonotum without black hairs intermixed (many black hairs intermixed in *californica*, but none in male of *texana*). Tegulae and tarsi ferruginous red. Flagellum somewhat reddened beneath. Length, about 12 mm., anterior wing, 8 mm.

Described from 1 ♂, 7 ♀ (holotype female, allotype and paratypes) at flowers of *Prosopis juliflora*, 5 1/2 miles west of Indio (at junction of

La Quinta and Palm Springs-Indio road), April 7 and 9, 1936 (Timberlake); 1 ♀ (paratype), Coachella Valley, Riverside County, June 14, 1933 (Margaret L. Cook); and 2 ♀ (paratypes), at flowers of *Sphaeralcea* and *Lycium fremontii*, Westmoreland, Imperial County, California, May 31, 1930 (Timberlake).

Anthophora fulvicauda, new species

Coming nearest to *A. urbana* Cresson but much larger, apex of abdomen of female with fulvous hair, the tarsi of male dark, with black hair beneath, hind basitarsi with a blunt projecting angle on anterior margin; tibial spurs of both sexes nearly black, etc.

FEMALE.—Black, the small joint of tarsi slightly reddened, the base of claws red; integument of tergites 5 and 6 more or less ferruginous red and the venter somewhat reddened especially at the sutures. Tegulae ferruginous. Wings hyaline, a little dusky in apical area and along anterior margin. Veins black. Antennae nearly black. Pubescence ochraceous, paler beneath and on the face and cheeks, much grizzled with black on the mesonotum, the vertex with much black hair. Tergite 1 with pale ochraceous hair, erect at base, becoming appressed and forming a fascia at apex. Tergites 2 to 4 with apical fascia of dense appressed pale hair (as in *urbana*), the band becoming narrower on 4. Area in front of bands with thinner, mostly appressed light hair (with black hair in *urbana*). Hair on tergite 5 and on sides of 6 golden fulvous, but hair at sides of 5 becoming pale ochraceous or whitish. The apical fringe on ventrites 2 to 6 fulvous, becoming whitish on 1 and at sides of 2 to 4. Hair of legs, especially of tibiae and tarsi ochraceous, strongly tinged with fulvous on front and middle tibiae and tarsi. Front femora with long white hair, the middle and hind femora with short hair. Hair on under side of tarsi and on under side of hind tibiae dark ferruginous, sometimes shaded with black. Fan at apex of hind basitarsi golden fulvous. Face broad, the eyes not diverging above. Clypeus convex, subrugosely, closely punctured. Bare concave space between ocelli and eyes shining, minutely punctured. Mesonotum very minutely granular tessellate and opaque. Scutellum and pleura closely obscurely punctured. Third antennal joint equal to the next three joints combined. Basal vein interstitial with nervulus. First recurrent received by second submarginal cell distinctly beyond the middle. Length, about 16 to 18 mm., anterior wing, 10.5 to 11.5 mm.

MALE.—Similar to the female and to the male of *A. urbana*. Black, with small spot on base of mandibles, labrum, clypeus, supraclypeal mark, lateral marks, and scape beneath (all almost precisely as in *urbana*), white. Flagellum beyond the fourth joint a little reddened beneath. Apical margin of tergites more or less whitish hyaline beneath the bands. Pubescence as in the female except that the vertex and mesonotum have less black hair and in one paratype none at all. (*Urbana* male has little or no black hair on these parts, although the female has considerable.) Hair on under side of tarsi and under side of hind tibiae blackish, with a reddish luster in some lights. Tergites 1 to 5 banded as in female, the band on 6 more golden. Hair on disk of tergites 1 to 6 black. Femora with white hair beneath, a little longer on front pair. Hair on outer side of tibiae and basitarsi golden ochraceous, mostly short and appressed. Eyes slightly diverging above (not so strongly as in male *urbana*). Third antennal joint a little longer than next two joints combined. Seventh

tergite with a bare pygidial area in middle, the sides with dense appressed golden hair. Apex of pygidial area moderately wide, a little rounded, and on each side at a lower level a small black acute tooth. Hind femora somewhat incrassate. Hind basitarsi rather broad, more than twice as wide as middle pair, the anterior margin with a short blunt tooth a little beyond the middle. Ventrite 6 deeply angularly notched in middle. Length, 11 to 13 mm., anterior wing, 8.9 to 10.3 mm.

Described from 1 ♂, 6 ♀ (holotype female, allotype and paratypes), collected at flowers of *Phacelia ramosissima* var. *suffrutescens* and *Scrophularia californica* var. *laciniata*, Riverside, California, May 31 to June 20 (Timberlake); 2 ♂ (paratypes) at flowers of *Beloperone californica*, Palm Canyon, Borego Valley, San Diego County, March 29, 1936 (Timberlake), and 1 ♂ (paratype) at flowers of *Eriodictyon crassifolium*, Andreas Canyon, near Palm Springs, Riverside County, April 24, 1932 (Timberlake).

Anthophora dammersi, new species

Like the preceding species, this runs to *A. urbana* Cresson and *A. washingtoni* Cockerell in Cockerell's table (1906), but it is much larger, nearly equalling *fulvicauda* in size, with hair at apex of abdomen fulvous, and hair band at apex of tergite 4 interrupted in middle. The female may be distinguished from *fulvicauda* by having the third antennal joint much longer, disk of tergites 2 to 4 with black hair in front of the band, the bands narrow and white. The male of *dammersi* differs from all the others in having middle tarsi densely clothed on outer side with a long brush of ferruginous hair.

FEMALE.—Black, the small joints of tarsi a little reddened, the tibial spurs nearly black. Tegulae ferruginous. Pubescence ochraceous or whitish, more or less white on face, cheeks and under parts of thorax and the abdomen. Vertex with much black hair and hair of mesonotum strongly grizzled with black. Hair of first tergite long and erect, but the apex with a narrow white band of shorter depressed hair. Tergites 2 to 4 with a narrow white apical hair band, that on 3 a little thinner in middle, that on 4 thinner and interrupted in middle. Apex of tergite 5 and sides of the pygidium with bright fulvous hair. Disk of tergites 2 to 5 with erect black hair, considerably longer on 4 and 5, but base of 2 with short erect white hair. Hair of venter much as in *fulvicauda*, but the apical fringes much longer. Hair of legs mostly ochraceous, but long fringe on front femora whitish, and hair on outer side of tarsi, anterior margin of middle tibia and hind margin of front tibia bright fulvous. Hair on inner side of tarsi dark ferruginous, margined with black on hind basitarsi, and hair on inner side of hind tibiae blackish. Fan of hair at apex of hind basitarsi bright fulvous. Hair on labrum golden. Wings dusky hyaline, the veins black. Face broad, the eyes hardly diverging above. Clypeus convex, closely, shallowly punctured. Concave space between ocelli and eyes shining, very minutely punctulate. Mesonotum dullish, very finely tessellate, and with close fine shallow punctures, except on small oval area on each side of middle on posterior part of scutum. Third antennal joint about as long as next four joints combined. Mandible when not worn has inner tooth at a considerable distance from apex and the shaft distinctly constricted half

way between inner tooth and base. Pygidium rather narrow, acute at apex. (In *fulvicauda* pygidium broad at base, ogivally narrowed to a rounded apex.) Length, 13 to 16 mm., anterior wing, 10.5 to 11.8 mm.

MALE.—Similar to the female, except in usual sexual characters, the white bands on abdomen poorly developed and soon worn off. Black, the labrum except reflexed margins and basal spot on each side, clypeus, transverse supraclypeal mark, lateral marks and under side of scape, white. Clypeus with small black sutural spot on each side in type but frequently with a broad black band, following suture from top generally not quite to anterior end. Lateral marks strongly concave above, the orbital extension reaching above antennal sockets. Small joints of tarsi ferruginous, but the apical joint and claws darker. Apex of tergites 1 to 6 whitish hyaline. Pubescence of head and thorax as in the female, the vertex with a few black hairs (many black hairs on vertex in males from Riverside and Perris). Hair of first tergite as in female, the apical band less distinct. White bands on apex of tergites 2 to 5 thin and soon worn off, apparently sometimes never developed on 4 and 5. Disk of tergites 2 to 6 with erect black hair, except base of 2, where the hair is white. Apex of 6 and nearly whole of 7 covered with pale fulvous to whitish hair. Hair of legs whitish, becoming blackish on inner side of hind tibiae, and dark ferruginous on inner side of tarsi. Outer side of tibiae with thin hair, becoming dense on hind margin. First four joints of middle tarsi on outer side and anterior margin of middle tibiae at apex covered with coarse rather long dark ferruginous hair, forming a dense brush, the apical joint of tarsus comparatively nude. Inner tooth of mandible much closer to apex than in female. Clypeus somewhat dullish, very finely and obscurely punctured. Third antennal joint somewhat longer than next three joints combined. Hind basitarsi hardly wider than middle pair and quite simple. Hind femora not incrassate. Apex of pygidial area nude and truncate, the sides of the segment obtusely angled near base. Apex of sixth ventrite with a broad, very shallow emargination. Length, about 12.5 to 15 mm., anterior wing, 10 to 11 mm.

Described from 3 ♂, 8 ♀ (holotype female, allotype and paratypes), at flowers of *Salvia carduacea*, Lovejoy Buttes, 7 miles north of Llano, Mohave Desert, California, May 2, 1937 (Timberlake); 1 ♀ (paratype), Kramer Hills, Mohave Desert, March 20, 1931 (C. M. Dammers); 1 ♀ (paratype), Michel's Cavern, San Bernardino County, May 18, 1935 (Dammers) in Dammers collection; 1 ♀ (paratype), Bonanza Mine, Providence Mountains, at flowers of *Amsinckia*, April 10, 1936 (Dammers); 1 ♀ (paratype) Gavilan Hills, 5 miles west of Perris, on *Ribes indecorum*, March 19, 1936 (F. R. Platt); 1 ♂ (paratype) at flowers of *Astragalus pomonensis*, 2 miles west of Perris, March 19, 1936 (F. R. Platt), this pair in Platt collection; 1 ♂ (paratype), Riverside, on *Amsinckia intermedia*, March 23, 1933 (Timberlake); and 12 ♂, 1 ♀ (paratypes) Palm Canyon, Borego Valley, San Diego County, 7 of the males collected by Dammers, March 14, 15, 1936 (2 in Dammers collection), the rest by Timberlake, March 29, at flowers of *Beloperone californica*.

Anthophora crotchii Cresson

A. crotchii is a rather common vernal species in California. Cresson described only the male, which is a beautiful insect and easily known by its bright fulvous pubescence, yellow face and black fan at apex of middle tarsi. After collecting in California for several seasons I wondered why I could find no female to match with *crotchii*. At the same time I found the female of *A. washingtoni* Cockerell and wondered what its male could be like. This female looks very different from *crotchii* male, having a pale pubescence and narrow, white bands on the abdomen. I finally concluded that *washingtoni* must be the female of *crotchii* in spite of the decided differences. They both have greenish eyes, unlike the other large vernal species, and frequent the same flowers. I have taken both at flowers of *Amsinckia* and *Lantana* which are attractive to all the vernal *Anthophora*, but both also visit the flowers of *Orthocarpus purpurascens*, which do not seem to attract any of the other species. I have also observed the *crotchii* male following and pouncing on the *washingtoni* female, so that the association of the two as the sexes of one species seems to be correct.

AMERICAN MUSEUM NOVITATES

Number 959

Published by
THE AMERICAN MUSEUM OF NATURAL HISTORY
New York City

Nov. 3, 1937

A PUG-HEADED TWO-LINED DAB, *LEPIDOPSETTA BILINEATA*, THE ONLY KNOWN PUG-HEADED FLATFISH

By E. W. GUDGER

Knowing my interest in and my work on abnormal flounders, Dr. Carl L. Hubbs of the University of Michigan has kindly presented to the American Museum this interesting little fish for description. It was collected at Meadowdale, Puget Sound, Washington, June 20, 1926, by C. L. Hubbs and L. P. Schultz.

Lepidopsetta bilineata is a dextral flounder found in the north Pacific, ranging from Monterey, California, to Bering Strait, and on the west side down into the Okhotsk Sea. The specimen being studied is evidently a very young fish since it measures but 100 mm. (4 in.) in length and 35 mm. in depth (body only), whereas adults reach a length of 20 inches and a weight of 5 or 6 lbs.

This two-lined *Lepidopsetta* is so named because it has an accessory supratemporal branch of the lateral line extending parallel with the base of the dorsal fin back to the 20th dorsal ray in this specimen. This fish is small, but with the one exception that it is simous or pug-headed, it seems entirely normal (Fig. 1). This deformity has not prevented the safe migration of the left eye to the right side of the head. There is a slight difference in the lengths of the pectoral fins; that of the upper side is 12 mm. long, while the one on the lower or blind side measures but 8.5 mm. However this is entirely normal for flatfishes, and it is well known that the under side pectoral, being less used than the upper fin, is smaller.

The lower jaw seems normal in length, but, judging by the published figures of the normal fish, it is entirely too thick and stubby. The front part of the head and most of the upper jaw are lacking (Fig. 1). The premaxillaries and maxillaries are greatly crumpled and distorted so that the twisted mouth lies wholly to the left of a plane continuing the mid-dorsal crest onto the central point of the lower jaw. This is shown somewhat in Fig. 2, from a photograph of the left, lower, or blind side of this little fish. To make these relationships clearer, and to show just how grotesque is the head in front view, Fig. 3 has been drawn. In it one

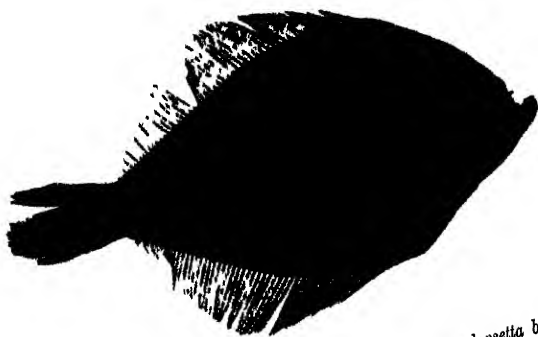


Fig. 1. Right or upper side of the pug-headed dab, *Lepidopsetta bilineata*. Note that the front upper head is lacking, that the eyes, closely juxtaposed, are protuberant, and that the nostrils are out of place.



Fig. 2. Under side of the two-lined dab. Note the accessory lateral line, the absence of the front upper head, and the contorted mouth displaced to the left side.

looks at the fish from in front and above—at an angle of about 45° to the plane of the backbone. The upper jaw looks as if the bones had been shoved downward in the center of the jaw in such a way as to curl the median parts downward and inward like two fishhooks turned upside down and with their barbed points brought close together. This upper jaw is surely an extraordinary teratological structure.

Accompanying the loss of the front part of the head, and the reduction, crumpling, and twisting of the upper jaw, other teratological conditions of the head structures have been brought about. The rotated eye is normally found close to the median ridge of the fish's head. Here, as Figs. 1 and 3 show, it has come safely across the dorsal crest but barely

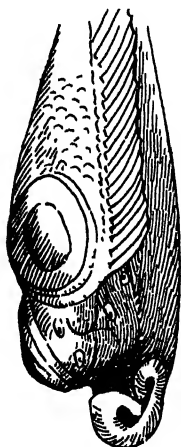


Fig. 3. Front view of head looked down on at an angle of about 45° . The crumpled mouth is on the left side, and behind it is a deep fossa, the rotated eye is barely over the dorsal crest, the right eye overhangs the fossa, and the nasal openings are out of place.

so. Its left edge almost touches the bases of the dorsal fin rays. The two eyes are normally set close to each other but here they are in absolute juxtaposition. The nasal apertures of the right side are normally one behind the other about in the plane of the lateral line. Here they stand at about an angle of 45° to the plane in which the figure is drawn—the horizontal plane of the body as the fish lies on the bottom. The narial apertures of the left side are even more displaced. These openings on the blind side are normally placed much higher toward the median ridge than those on the eyed and colored side. In our fish, however, the lower or anterior is placed squarely on the median crest (or in the vertical plane of the body). The hinder one is on the left side of the body but high up and just to the left of the front edge of the base of the dorsal fin.

In and around these nasal organs are various rugosities as shown in Fig. 3.

The mouth is strongly up-tilted in front. Behind it is a fossa, fairly shallow on the left but very deep on the right side. The hard parts fall away so abruptly that at this angle the right or lower eye completely overhangs the lower part of the right side of the head. At this angle the lower eye seems to look downward, but this is not true as Fig. 1 shows.

What this little fish fed upon cannot be said, but it surely has managed to get food enough to attain a length of 100 mm. (4 inches). That it did not feed so easily nor grow so fast as its normal brothers did may be accepted as a sound inference. But the fish looks fat and well fed, and is probably two or more years old. If one could only have followed its development from the time of hatching!

During the years that I have been engaged in studying abnormalities in flatfishes, about 175 specimens have passed through my hands. Furthermore, during this time, I have studied the figures and descriptions in the literature of every abnormal flatfish of which I could get even a hint. In these hundreds of figures and descriptions, there seems never before to have been seen and figured a bulldog-headed flatfish. This little bilincate dab is a unique specimen—the only one known.

As to the cause of this anomaly, one is puzzled. It is known that in pug-headed fishes, as in pug-headed dogs, this condition is due to failure to develop of the parasphenoid bone, the great bone forming the basis cranii. This failure to elongate ties down into a snub-nosed form the whole front end of the head, while the lower jaw goes on in normal development. There is, however, a very marked variant to this. Sometimes pug-headed dogs and fishes have very protuberant eyes—as does our fish (Figs. 1 and 3). In this case, and in exaggerated ones in any round-bodied fishes, the eyes are enlarged and so protuberant that they seem almost ready to “pop out of the head.” This combined condition of exophthalmic eyes and pug-headedness is due to the same cause. The parasphenoid instead of elongating normally, or growing straight forward even though shortened, has “buckled up” into the cavity in the head (normally between the eyes) and has produced a marked exophthalmia. What is the condition of the bones in the anterior part of the skull in this little fish can only be conjectured, but the exophthalmia is present as may be seen in Fig. 1. Such exophthalmia has possibly never been seen before in a flatfish; certainly it has not been described previously.

As to what causes the failure of the parasphenoid to develop or what leads to the weakness which causes it to buckle up, one must again con-

jecture. It is commonly believed that these things are the product of a glandular disturbance—probably in the pituitary.

In this little dab, there is quite a list of abnormalities consequent upon the failure of the parasphenoid to develop. These are: the front part of the upper head is lacking; the upper front jaw is crumpled inward and downward; the mouth is twisted to the left; there is a marked cavity or depression behind and to the right of the upper jaw; both sets of nostrils are very much displaced; the left eye is barely over the dorsal crest, and the two eyes are protuberant and are jammed so closely together that there is hardly any line of demarcation between them. The amount and extent of deformation of the head and mouth of this fish are surely at a maximum.

AMERICAN MUSEUM NOVITATES

Number 960

Published by
THE AMERICAN MUSEUM OF NATURAL HISTORY
New York City

Nov. 3, 1937

BEEES FROM MOROCCO

By T. D. A. COCKERELL

The bees recorded below were obtained on the Cockerell-Mackie Expedition of 1930.¹ The holotypes are all in The American Museum of Natural History.

Halictus albomaculatus Lucas

The species which I recorded from Morocco as *H. major* Nylander, female, is evidently *H. albomaculatus*, as Blüthgen has suggested. It is extraordinarily like *H. major*, but may be distinguished by the broad bands of white tomentum at bases of tergites, the difference from *H. major* being especially noticeable on the fourth. Blüthgen further suggests that my *H. phanerodontus* is really the male of this species. I compared it with a male of *H. separandus* Frey-Gessner, which is considered a synonym of *H. albomaculatus*, and found it to be distinct. *H. separandus* is the European form, and it may be that it is after all separable. Lucas describes the male of his *H. albocinctus*, which is considered to be a synonym of *H. albomaculatus*, but the description is so brief and general that it is impossible to reach any decision from it. The much less distinct abdominal bands (as compared with the female) do not seem characteristic. It is possible that there is a series of species of this group, as of *Monilapis*, but if so, the fact awaits adequate demonstration. I find I have a second male of *H. phanerodontus*, from Ifrane, August (W. P. Cockerell). The face is appreciably narrower than in the type, and the supraclypeal area is largely hidden by hair, not exposed and shining as in the type. The clypeus is somewhat ridged in the middle, and the hind basitarsi are largely darkened. The venter of the abdomen does not differ. The Ifrane locality is in the Middle Atlas, and it is possible that a different race is represented.

Halictus ifranicola, new species

FEMALE.—Length about 10 mm., anterior wing 7.7 mm.; very robust, with broad-oval abdomen; black, including mandibles and antennae (flagellum very obscurely brown beneath), but all the tarsi dusky red, the knees narrowly red, the

¹ For particulars, see "Natural History," XXXI (1931), pp. 309-317. (On p. 315, second column, for August 7 read September 7, and on p. 317 read Mr. Joseph Nurra.)

tibiae obscurely red at apex; hair of head and thorax rather scanty, dull pale fulvous. Head broad, approximately circular, the clypeus not produced; clypeus convex, shining, coarsely punctured; supraclypeal area shining; sides of face and front very densely punctured but glistening, no smooth line next to orbits; sides of vertex dull and excessively densely and finely punctured, but a little smooth space next to each lateral ocellus. Mesonotum closely and finely punctured, but shining on disc, median sulcus distinct; scutellum densely and coarsely punctured in middle, but at each side with a polished area; mesopleura strongly punctured, and with much long hair; area of metathorax crescentic, poorly defined, the surface with a weak reticulate sculpture, with some short plicae at base; posterior truncation dull, not sharply defined above; tegulae pale brown, clouded with darker, and with hyaline margins. Wings very strongly reddened; stigma clear red, nervures reddish; second cubital cell higher than broad, parallel sided, receiving recurrent nervure a considerable distance from end; third cubital broad. Legs with fulvescent hair, dense on hind tibiae; hind spur with four short brown teeth. Abdomen very broad, dull (including first tergite), and excessively densely and finely punctured; hair-bands on apices of tergites pale fulvescent, on first reduced to a transverse mark at each side, on second rather broadly interrupted, on third and fourth entire, but weak in middle; apex with fulvescent hair; ventral segments narrowly pallid on margins, and with much outstanding hair.

Morocco: Ifrane, Aug., 1930 (Alice Mackie).

In Blüthgen's table in Konowia, 1923, this runs to *H. patellatus* Morawitz, which differs by the distinctly shining abdomen, the middle of scutellum flat and shining, and the dark tegulae. From *H. fumatipennis* Blüthgen it differs by the dark antennae and more red on legs; in Blüthgen's table of Spanish species it would run best to *H. patellatus* but, disregarding the color of the legs, it runs to *H. fumatipennis*, differing by the light red or reddish stigma and nervures, and smaller size. It is also near *H. tetrazoniellus* Strand, from Cyprus.

Halictus leucozonius Schrank

We collected both sexes in some numbers at Ifrane and Asni, and I got one female at Fez, Sept. 6.

Halictus costulatus Kriechbaumer

Both sexes at Ifrane (W. P. Cockerell); a male at Asni, Aug. 11 (Cockerell).

Halictus callizonius Pérez

Males at Ifrane (A. Mackie) and Asni (Cockerell). Females from Tangier, July 31, collecting bright orange pollen (Cockerell) and Mogador, Aug. 20, collecting lemon-yellow pollen (W. P. Cockerell).

***Halictus (Monilapis) rejectus*, new species**

Halictus quadripartitus Blüthgen (err. det.), COCKERELL, 1931, Ann. Mag. Nat. Hist., June, p. 529. (Ifrane, Morocco. Male.)

Blüthgen (Jahrb. Nat. Ges. Graubündens, LXXI, p. 58) declares that my insect cannot be his *H. quadripartitus* and, on reviewing the subject, I must agree. He suggests, however, that it may be *H. maroccanus* Blüthgen, which he describes from Ifrane at the place cited. I was at first inclined to accept this solution, but a close study of the description brings out too many discrepancies. My bee is larger (length about 11.5 mm., anterior wing, 8 mm.), and the flagellum is black, with only a faint brownish tinge beneath (the third antennal joint has an orange spot, as in *H. maroccanus*). The first tergite (contrary to Blüthgen's description of *maroccanus*) is formed as in *H. simplex* Blüthgen (a specimen determined by Blüthgen compared), only the pure black apical margin is entirely dull, whereas in *simplex* it is shining. Blüthgen, comparing his insect especially with *H. simplex*, mentions no difference in the malar space; in *simplex* it is well developed and shining, in my insect shorter, dull in middle. The face is broader than in *simplex*, and the pure black eyes are longer; the antennae are very long, reaching end of thorax. The tergites are not brown at end, and the fifth tergite has an entire white band, lacking in *H. simplex* (this is true of *H. maroccanus*). The margin of the fourth sternite is evenly concave, as in *H. simplex*, and the margin of the fifth is similar. The wings are clear, a little dusky at apex, and the stigma is dark reddish brown (very pale, with a dark border, in *simplex*). The abundant hair of head and thorax is grayish white. The form of the fifth ventral segment distinguishes this from *H. quadripartitus*, and there are other differences. The mandibles not broadened at base at once separate it from *H. tomentosus* Eversmann, and the anterior basitarsi not broadened from *H. patellatus* Morawitz. The entirely black labrum and mandibles distinguish it from such species as *H. tetrazoniellus* Strand.

***Halictus (Evylaeus) lucidellus*, new species**

FEMALE.—Length about 5 mm., anterior wing 3.5 mm.; rather slender, black, including mandibles and legs, but the flagellum dusky red beneath, the tegulae (which are not punctured) so dark brown as to be practically black. Head oblong, longer than broad, with the clypeus produced; clypeus, supraclypeal area and sides of face shining; front somewhat shining under a lens, but the microscope shows dense punctures which extend almost to the anterior ocellus, leaving only a little crescentic, smooth space in front of it (in *H. lucidulus* the front has dense punctures on a striatulate surface, but there is a smooth area in front of anterior ocellus, nearly as large as the ocellus). Mesothorax small, it and the scutellum appearing highly polished under a lens, the mesothorax with very minute, widely separated punctures, and the anterior

middle microscopically striatulate (*H. lucidulus* is similar, but the punctures on disc are larger and somewhat closer, and the parapsidal grooves are very much coarser); median groove of mesothorax distinct; scutellum very large, flattened in middle, with sparse minute punctures; area of metathorax large, entirely dull and minutely sculptured, with very irregular, often imperfect, weak plicae on basal half (in *H. lucidulus* it is quite different, the basal half with strong dense rugae, the valleys between them shining); postscutellum with very inconspicuous tomentum on its anterior border (densely white-tomentose anteriorly in *H. lucidulus*). Wings dusky hyaline, brilliantly iridescent, the nervures pale brown, the large stigma reddish brown, second cubital cell receiving recurrent nervure well before end (at extreme corner in *H. lucidulus*, which has browner wings). Hair on inner side of hind basitarsi clear white, but the brush at end yellow; hind spur white, with four small short brown teeth. Abdomen shining black, the margins of the tergites not evidently pallid, though the depressions appear brownish under the microscope; a thin inconspicuous rounded spot of pale hair at lateral bases of second and third tergites; first tergite with excessively minute punctures; apical tergites with long hairs.

Morocco: Asni, Aug., 1930 (A. Mackie).

I had this labelled *H. lucidulus*, but it is evidently distinct. According to Blüthgen, *H. gracilis* Morawitz is a synonym of *H. lucidulus*, and it has indeed the same kind of metathoracic area. But it resembles the species just described in having the punctures of front nearly up to median ocellus, and the parapsidal grooves very delicate. The wings are distinctly brownish, and the second cubital cell receives the first recurrent nervure well before the end. The tegulae in *H. lucidulus* are dark as in *H. lucidellus*, but in *H. gracilis* they are red. The specimen of *H. gracilis* compared was determined by F. Morawitz, and is marked "Petrop.," which I take to be the modern Leningrad.

H. minutissimus Kirby is easily distinguished from *H. lucidulus* and *H. lucidellus* by the mesonotum, which is minutely tessellate and dull from front to back, while the scutellum has no polished spaces. The English (Isle of Wight) *H. minutissimus* compared has the first recurrent nervure meeting the intercubitus, whereas in the specimens from Morocco it joins the apical part of second cubital cell. Some of the Asni specimens, which I had placed as *H. minutissimus* variety, are to be referred to *H. lucidulus*, but my series assigned to that species is variable, and even after the removal of *H. lucidellus* (which differs from all by the shape of the head), may be composite. One form has the wings conspicuously reddened.

Halictus malachurus Kirby

Morocco: Tangier, one female July 31, six males, July 30–Aug. 1 (Cockerell).

Blüthgen, in his work on Spanish *Halictus*, cites a good character for

H. malachurus in the depression or pit at the end of the large, finely sculptured area of metathorax. It is evident in females which my wife and I collected at St. Helens, Isle of Wight, which are certainly Kirby's species. Blüthgen places female *H. subhirtus* Lepeletier in the series of which it is said, "area central, en su extremo, no deprimada." But Lepeletier describes *H. subhirtus* from the vicinity of Paris, and expressly says, "metathorace subemarginato." Blüthgen remarks that from the description of Lepeletier it is impossible to be really sure (no se comprende bien) what species he had. Considering the locality and the description, it would seem that he had *H. malachurus*. I have a series of one female and three males, labelled *H. subhirtus*, with the locality "Bord." (I presume Bordeaux.) They were collected by Pérez. As seen under a lens, the female has the clypeus shining practically all over, and the broad white margins of the second and third tergites are very conspicuous and sharply defined. The males, however, are of two sorts. In one specimen the area of metathorax is large, with extremely fine sculpture, and the apical dimple: all as in *H. malachurus*. In the other two it is short, coarsely plicate, and without any median depression. The difference certainly seems to indicate two species. Now Blüthgen, in his table of males, separates *H. subhirtus* from *H. malachurus* on this very character. (Area central del metatórax con arrugas fuertes hasta el apice, el cual no está hundido en su centro.) I think there is no doubt that those specimens are *H. subhirtus* as understood by Blüthgen.¹ In the case of the female, the clypeus of *H. malachurus*, seen under a lens, has the upper part more or less distinctly opaque, although the microscope reveals no marked difference in sculpture. The conclusion would then seem to be that there are, in fact, two distinct species, as interpreted by Blüthgen, in France and Spain, but that probably the original *H. subhirtus* was *malachurus*. The species very common at Tangier, and obtained by various collectors, is *H. malachurus*, but Nadig got a male of *H. subhirtus*, as determined by Blüthgen, at Asni. In 1923 Blüthgen recorded *H. subhirtus* from Amismiz and Marrakech. There is, however, still another complication. I have before me a female and a male (the latter borrowed from the American Museum), labelled "Weissnfls.," determined by Friese as *H. malachurus*. The male has the *H. subhirtus* (as above defined) type of metathorax, but it differs from my *H. subhirtus* males by the more slender abdomen, with the first tergite evidently narrower. The female has the area of metathorax large and rough, with no apical dimple. The clypeus

¹ M. L. Berland writes that the type of *H. subhirtus* cannot be found in the Paris Museum. It seems so nearly certain that it was *H. malachurus*, that I propose *H. malachurops*, n. n., for *H. subhirtus* as understood by Blüthgen and Pérez.

of the female does not appear to differ from that of English *H. malachurus*, but the tegulae differ, being shorter and reddened in middle. But the Morocco *H. malachurus* females (I have four, in addition to the one I took) have small reddish tegulae. They are also less robust than English specimens.

***Halictus malachurus sharificus*, new subspecies**

MALE.—Abdomen with the first three tergites pale red, or marked with red, varying as follows:

VAR. 1.—First tergite with the shoulders and a pair of transversely oval discal spots black; second tergite with similar spots, but much more widely separated, and elongated marks at extreme sides; third tergite with these marks united on each side, and a faint dusky shade across the disc. Flagellum bright ferruginous beneath. Tegulae hyaline, with a light yellow spot. Wings reddish. Marks on outer side of hind tibiae black. Tangier, July 31 (Cockerell).

VAR. 2.—Similar, but marks on each side of first tergite united to form a C, on second united to form a curved band, on third forming an entire transverse band, thickened in the middle. Tangier, Aug. 1 (Cockerell).

VAR. 3.—Similar in most respects, but first tergite black with a large quadrate median red patch, and red in middle before the depression; second tergite with an entire broad transverse black band; third mainly black, but a narrow red band before the depression. Hind tibiae with a large black mark. Tangier, Aug. 2 (Cockerell).

VAR. 4.—Similar to the last, but third tergite red at base except in middle. Marks on hind tibiae light red. Tangier, July 30 (Cockerell).

VAR. 5.—More robust, with very broad second cubital cell; tegulae pale testaceous with a light yellow spot. Patches of pale tomentum at sides of base of second and third tergites large and conspicuous; first tergite black with a square red mark on disc; second and third each with a transverse red mark, pointed at each end, that on third smallest; last sternite with apical half pale yellowish. Hind tibiae with a large red patch on inner side, and a smaller black one on outer. Anterior wings 6 mm. long. Asni, Aug. 8. (Alice Mackie).

These bees are easily known from *H. fratellus* Pércz (*frey-gessneri* Alfken) by the closely and distinctly, though minutely, punctured first tergite. Male *H. albipes* Fabricius, with red on the abdomen, differs in respect to the metathorax and the very long, comparatively dark antennae.

In 1933 (the paper was received Nov. 28, 1933), in his account of Nadig's *Halictus*, Blüthgen reported three males of the *sharificus* form from Tangier, but did not propose a special name for them. The holotype of *H. malachurus sharificus* is variety 1, above. This is the most extreme departure from typical *H. malachurus* but, if the name is used in a subspecific sense, it will presumably have to include all the Tangier *H. malachurus*.

A female labelled *H. longulus* Smith (which has been proved to be conspecific with *H. malachurus*), collected in Egypt by Ehrenberg, received from the Berlin Museum, has the smaller, reddish tegulae, and the upper part of clypeus appearing dull. The wings are reddish, and the nervures are pale reddish. Typical *H. longulus* is British, but Smith reported it also from Italy. The Egyptian insect appears to go with the form found in Morocco.

***Halictus (Evylaeus) rufulocinctus*, new species**

MALE.—Length about 6.2 mm., anterior wing about 5.5 mm.; black, with a broad white triangular area on apical part of clypeus; labrum with a yellow band across upper part; mandibles pale yellowish in middle, red at end; knees, tibiae, and tarsi pale reddish, the tibiae mainly black in middle; margins of tergites rather narrowly but very distinctly red. Head oblong, rather broad, the clypeus not much produced; head and thorax with grayish-white hair, moderately abundant on face, but not hiding surface; clypeus and supraclypeal area shining; front dull, with a shining band along orbits; cheeks hardly as broad as eyes; antennae short for a male, not reaching scutellum, flagellum obscure brown beneath, the middle joints not much longer than broad. Mesothorax and scutellum very highly polished, with weak punctures; no strong median groove on mesothorax; postscutellum short, with thin hair; area of metathorax very large, dull and rugulose all over, the apical margin obtuse but shining, depressed in middle (the microscope shows the area to have fine rugae forming an irregular network, and the apical part with minute transverse striae); posterior truncation obtusely bounded at sides above; mesopleura shining; tegulae small, clear red. Wings long, hyaline, faintly dusky apically; stigma dark reddish brown, basal and marginal nervures dark, those in middle of wing very pale; second cubital cell broad, its outer side sloping, the recurrent nervure received near end. Hind tibiae very hairy. Abdomen long oval, highly polished, without hair-bands or spots; the microscope shows rather dense but excessively minute and weak punctures on first tergite.

Morocco: Ifrane, Aug. 26 (A. Mackie).

This may be compared with *H. converiusculus* Schenck, from which it is easily known by the much darker stigma, and with *H. ventralis* Pérez (*combinatus* Blüthgen), from which it is known by the highly polished mesonotum. It is much too large for *H. lucidulus* Schenck or *H. semilucens* Alfken.

***Halictus (Evylaeus) asnicus*, new species**

MALE.—Length about 4.5 mm., anterior wing 3 mm.; black, with rather broad, not at all cylindrical, abdomen, and scanty whitish hair, not forming bands or spots on abdomen, but long and abundant on postscutellum. Head broad-oval; clypeus produced, with a broad whitish margin; labrum with a pale band; no light spot on base of mandibles; clypeus polished, with distinct punctures; supraclypeal area

small and highly polished; front shining but closely punctured, no smooth band along orbits; scape short, intense black; flagellum very long, light yellow beneath, dusky brownish above. Mesothorax and scutellum highly polished, finely punctured; mesopleura shining but well punctured; area of metathorax short, dull, with a shining border behind; posterior truncation shining, not sharply bounded; a small yellow spot on tubercles; tegulae very small and pale. Wings clear hyaline, iridescent, with very pale stigma and nervures. Legs black, the tarsi yellowish white, darkened at end; hind tibiae pale at base. Abdomen shining, the hind margins of the tergites rather broadly pallid.

Microscopic characters: front well punctured all over, except an impunctate band running down from middle ocellus; mesothorax shining, with well separated distinct punctures, and no median sulcus; tegulae not punctured; area of metathorax short, with rather strong but irregular plicae on basal half, the apical half smooth and dull, with a well-defined curved margin; posterior truncation not sharply bordered at sides above, the broad surface punctate; second cubital cell narrow, receiving recurrent nervure a moderate distance from end; third cubital not produced apically; abdomen closely and well punctured on tergites 1, 2, and basal half of third, the rest of third, and the fourth dull and impunctate.

Morocco: Asni, Aug. 12 (A. Mackie).

In Blüthgen's table of Spanish species it runs to 71, and it is a little doubtful whether the area of metathorax should be considered distinctly bounded or rounded behind. If the former alternative is chosen, it runs out on account of the dark base of mandibles combined with light band on labrum, and also on account of its small size. Choosing the latter alternative, it runs to 77, and has the head oval, and the second tergite well punctured as far as the short apical depression. It then goes on to 84, the second and third tergites being without depressions or incisions at base, and eventually it comes out with *H. griseolus* Morawitz. On comparison with *H. griseolus*, from Cyprus (Mavromoustakis), it is entirely different by the much longer antennae, and highly polished mesonotum. By the long antennae and shining mesonotum it resembles *H. politus* Schenck, but that differs at once by the dark antennae and stigma. It has the antennae and stigma much as in *H. semipunctulatus* Schenck, but that is considerably larger, with a long narrow abdomen. It agrees with no species reported from Morocco. I have not seen *H. musculus* Blüthgen, but that has the mandibles marked with yellow, and more yellow on legs. The under side of flagellum is ochre yellow. Pércz, in his paper on Barbary bees (1895) described *H. decolor*, *H. musculus*, and *H. mozabensis* from females, which in coloration more or less approached the condition normal for male *Haliectys*. It is conceivable that the present insect is the male of one of these, but I think not likely. They all have considerable pubescence on the abdomen.

Halictus (Curtisapis) mogadoricus, new species

FEMALE.—Length about 6.5 mm., anterior wing 5 mm.; intense black, including the strongly curved mandibles, but the flagellum obscure brown beneath; pubescence on head and thorax dull white, rather scanty, finely plumose at sides of face. Head approximately circular, but clypeus distinctly produced; clypeus shining, coarsely punctured; supraclypeal area shining; front dull and densely punctured, with a shining band along orbits; vertex shining. Mesonotum dullish, moderately shining on disc, with very dense distinct punctures, readily visible under a lens; median sulcus distinct; much hair in region of tubercles; mesopleura coarsely sculptured; scutellum for the most part dull and very densely punctured, but bigibbous, the elevations shining; postscutellum anteriorly with dense white tomentum; area of metathorax subtriangular, sharply defined, with strong straight plicae extending to margin, the intervals shining; posterior truncation dullish, very coarsely sculptured, sharply bounded all round; tegulae small, very dark brown. Wings hyaline, faintly dusky, stigma and nervures dark brown; second cubital cell higher than broad, receiving recurrent nervure near end. Legs black, the tarsi somewhat reddened apically; hair on inner side of basitarsi white; hind tibiae with some almost black hair on outer side; hind spur serrulate, with about seven short obtuse brown teeth.¹ Abdomen with broad bands of pure white tomentum at bases of second to fourth tergites; hair bordering caudal furrow reddish; margins of tergites not discolored; first tergite rather narrow, brilliantly polished, but finely and closely punctured, the broad marginal depression duller and more finely punctured; the other tergites are dullish with a rather sericeous gloss, very finely and closely punctured.

Morocco: Mogador, at flowers of *Gaillardia*, Aug. 19 (W. P. Cockerell).

Related to *H. callizonius* and *H. leucozonius*, but smaller, with different metathorax. There is some resemblance to *H. pseudocaspicus* Blüthgen from Cyprus, but compared with that it is much less robust, with narrower face, and abdomen not so broad at base.

H. interruptus Panzer, taken at Ifrane, Aug. 26 (A. Mackie) is readily separated by the clypeus not being produced, the sides of the face not polished, and the tegulae red on outer side. Although Mogador and Marrakech are not far apart, they have entirely different climates. We left Marrakech in suffocating heat, but found Mogador, on the coast, windy and almost cold. This contrast is well known to every resident of Morocco, and travelers are warned to provide themselves with clothing adapted to the two extremes.

¹ The pollen collected is pale yellow.

AMERICAN MUSEUM NOVITATES

Number 961

Published by
THE AMERICAN MUSEUM OF NATURAL HISTORY
New York City

Nov. 10, 1937

REPORT ON A COLLECTION OF SPIDERS FROM MEXICO. I

By W. J. GERTSCH AND L. IRBY DAVIS

While on an automobile trip through Mexico during the months of June and July, 1936, Mr. and Mrs. L. Irby Davis collected spiders at some fifty stations located in thirteen different states and in the federal district. Every type of association from tropical swamp to the driest desert was encountered. The altitude varied from sea level to about fifteen thousand feet. The distribution of the stations according to states was as follows: Distrito Federal, 1; Tamaulipas, 3; Nuevo Leon, 11; Coahuila, 5; Durango, 2; San Luis Potosi, 2; Hidalgo, 3; Mexico, 6; Michoacan, 1; Morelos, 1; Guerrero, 5; Tlaxcala, 1; Puebla, 3; and Vera Cruz, 6. The location of the large number of stations in Nuevo Leon was due in part to the great length of the state and partly to the desire of the collectors to obtain material which might be similar to that recently collected in Texas; and the comparatively large number in the small state of Mexico was due to the great variation in altitude.

The collection has proved to be especially interesting because particular emphasis was given to the small, secretive species. The family arrangement is that of the latest paper on spider phylogeny by Dr. Alexander Petrunkevitch. In the following pages records and descriptions are given of the representatives from the Dipluridae through the Micryphantidae. The types of the twenty species described as new are deposited in the collection of The American Museum of Natural History.

Dipluridae

Ischnothele digitata (Cambridge)

Macrothele digitata CAMBRIDGE, 1892, 'Biol. Centr. Amer.,' I, p. 92, Pl. XII, fig. 3.

RECORD.—Vera Cruz: Vera Cruz, June 22, 1936, one young female (Davis).

Euagrus mexicanus Ausserer

Euagrus mexicanus AUSSERER, 1875, Verh. Zool.-Bot. Gesell., Wien, XXV, p. 160, Pl. v, figs. 13-16.

RECORDS.—Coahuila: five miles west of Saltillo, July 5, 1936, immature female (Davis). Michoacan: Zitacuaro, June 17, 1936, immature females (Davis). Puebla: seven miles south of Tlacotepec, June 24, 1936, immature females (A. M. and L. I. Davis). Tlaxcala: Tlaxcala, June 26, 1936, immature females (Davis). Morelos: Cuernavaca, June 20, 1936, female (Davis). Guerrero: Iguala, June 19, 1936, immature females (A. M. and L. I. Davis). Mexico: Las Cruces, June 28, 1936, female (Davis).

***Euagrus comstocki* Gertsch**

Euagrus comstocki GERTSCH, 1935, American Mus. Novitates, No. 792, p. 3, Figs. 2, 7, and 8.

RECORDS.—Coahuila: twenty miles east of San Pedro, July 5, 1936, female, (A. M. and L. I. Davis). Nuevo Leon: forty-two miles north of Monterrey, July 7, 1936, immature female (Davis).

Aviculariidae

***Eurypelma steindachneri* Ausserer**

Eurypelma steindachneri AUSSERER, 1875, Verh. Zool.-Bot. Gesell., Wien, XXV, p. 199, Pl. VII, figs. 43 and 44.

RECORD.—Nuevo Leon: forty-two miles north of Monterrey, July 7, 1936, immature female (Davis).

Urocteidae

***Oecobius isolatus* Chamberlin**

Oecobius isolatus CHAMBERLIN, 1924, Proc. California Acad. Sci., (4) XII, p. 584.—CHAMBERLIN AND IVIE, 1935, Ann. Ent. Soc. America, XXVIII, p. 270, Pl. I, fig. 2.

RECORDS.—Tamaulipas: fifteen miles south of Victoria, July 2, 1936, immature female (A. M. and L. I. Davis). Guerrero: Iguala, June 19, 1936, immature female (A. M. and L. I. Davis).

***Oecobius beatus*, new species**

Figures 1 and 2

FEMALE.—Total length, 2.00 mm.

	CARAPACE	FRONT	STERNUM	LABIUM	MAXILLA	ABDOMEN
Length	0.67	0.28	0.45	0.08	0.16	1.30 mm.
Width	0.74	0.40	0.46	0.12	0.10	1.00 mm.

Integument of the carapace with a sparse covering of inconspicuous hairs most numerous on the margins. Carapace dull yellow, with a black margin and with a row of spots just above which may be connected to the marginal seam. Eye region

and area behind it dull brown, the eye tubercles ringed with black. Pattern of carapace and abdomen as shown in Fig. 1. Carapace suborbicular, the front produced to a blunt point, the median groove obsolete. Carapace highest just behind the ocular area, declining rather abruptly on all sides.

Eyes of the first row procurved as seen from in front, essentially straight as viewed from above, the medians separated by their diameter, subcontiguous with the slightly larger laterals. Ratio of the eyes: ALE:AME:PLE:PME = 6:5:8:7. Posterior row of eyes procurved, the medians elongate, roughly subtriangular, separated by their short diameter, half as far from the large round laterals. Median ocular quadrangle longer than broad (18/14), slightly wider in front (14/12.5). Clypeus sloping and protruding, equal in height to more than the height of the median ocular quadrangle (24/18).

Sternum about as long as broad, pale yellow, clothed with pale hairs. Labium dusky, broader than long. Coxae pale yellow but the first two pairs with small smudges on the sides. Legs pale yellow, sparsely clothed with rows of black hairs, marked with black annulae which are incomplete above, two on each joint of all femora, tibiae, and metatarsi, one on the patellae. Terminal annulus of the metatarsi forming a complete ring. Tibiae and patellae of the four legs subequal in length, 0.80 mm., 0.80 mm., 0.77 mm., and 0.82 mm., respectively. Abdomen suboval, more pointed behind, the pattern as illustrated in Fig. 1. Epigynum as in Fig. 2.

TYPE LOCALITY.—Guerrero: female holotype and immature paratypes from Acapulco, June 17, 1936 (L. I. Davis). Immature female paratype from sixty-two miles north of Acapulco, June 18, 1936 (A. M. and L. I. Davis).

This species, the fifth member of the genus to be described from North America, is best separated from the other forms by reference to the genitalia.

Filistatidae

Filistatoides insignis (Cambridge)

Filistata insignis CAMBRIDGE, 1896, 'Biol. Centr. Amer.', I, p. 211, Pl. xxvi, fig. 12, Pl. xxviii, fig. 8.

RECORD.—Guerrero: Acapulco, June 17, 1936, two females (Davis).

Filistata hibernalis Hentz

Filistata hibernalis HENTZ, 1842, Journ. Boston Soc. Nat. Hist., IV, p. 227, Pl. viii, fig. 6.

RECORDS.—Nuevo Leon: forty-two miles north of Monterrey, June 7, 1936, immature female (Davis). Fifty-four miles south of Laredo, Texas, July 1, 1936, immature examples (Davis). Monterrey, June 10, 1936, immature female (Davis). Coahuila: five miles west of Saltillo, July 5, 1936, immature female (A. M. and L. I. Davis). Guerrero: Iguala, June 19, 1936, female (A. M. and L. I. Davis). Puebla:

seven miles south of Tlacotepec, June 24, 1936, immature females (Davis). Morelos: Cuernavaca, June 20, 1936, immature females (Davis).

Scytodidae

Scytodes intricata Banks

Scytodes intricata BANKS, 1909, Proc. Acad. Nat. Sci. Philadelphia, p. 196, Pl. VI, fig. 24.

RECORDS.—Nuevo Leon: seventy-six miles north of Monterrey, July 7, 1936, one female (Davis). Monterrey, June 10, 1936, immature female (Davis).

Scytodes fusca Walckenaer

Scytodes fusca WALCKENAER, 1837, 'Ins. Apt.,' I, p. 272.

RECORD.—Guerrero: Acapulco, June 17, 1936, female (Davis).

Scytodes perfecta Banks

Scytodes perfecta BANKS, 1898, Proc. California Acad. Sci., I, p. 210, Pl. XIII, fig. 2.

RECORDS.—Durango: Lerdo, July 4, 1936, three females (Davis). One mile west of Lerdo, July 4, 1936, immature female (Davis).

Pholcidae

Physocyclus dugesi Simon

Physocyclus dugesi SIMON, 1893, Ann. Soc. Ent. France, LXII, p. 320.

RECORD.—Guerrero: Chalpincingo, June 16, 1936, male and female (Davis).

Physocyclus enaulus Crosby

Physocyclus enaulus CROSBY, 1926, Proc. Ent. Soc. Washington, XXVIII, p. 1, Pl. I, fig. 1.

RECORD.—Coahuila: seventy-five miles east of San Pedro, July 5, 1936, two males, one female (Davis).

Modisimus texanus Banks

Modisimus texanus BANKS, 1905, Proc. Ent. Soc. Washington, VII, p. 94.

RECORDS.—Nuevo Leon: five miles west of Monterrey, July 6, 1936, male and female (Davis); twenty-eight miles north of Monterrey, July 7, 1936, male and female (Davis); seventy-six miles north of Monterrey, July 7, 1936, two immature females (Davis). Tamaulipas: seven miles south of Hidalgo, July 3, 1936, male and female (Davis). San Fernando, March 28, 1937, males and females (Davis).

Modisimus inornatus Cambridge

Modisimus inornatus CAMBRIDGE, 1895, 'Biol. Centr. Amer.,' I, p. 149, Pl. xx, fig. 7, Pl. xxxii, fig. 4.

RECORD.—San Luis Potosi: five miles north of Tamazunchale, July 2, 1936, males and females (A. M. and L. I. Davis).

Modisimus guerrerensis, new species

Figures 3, 4, and 5

FEMALE.—Total length, 2.30 mm.

	CARAPACE	FRONT	STERNUM	LABIUM	MAXILLA	ABDOMEN
Length	0.73	0.53	0.34	0.08	0.20	1.60 mm.
Width	0.67	0.33	0.50	0.16	0.13	1.30 mm.

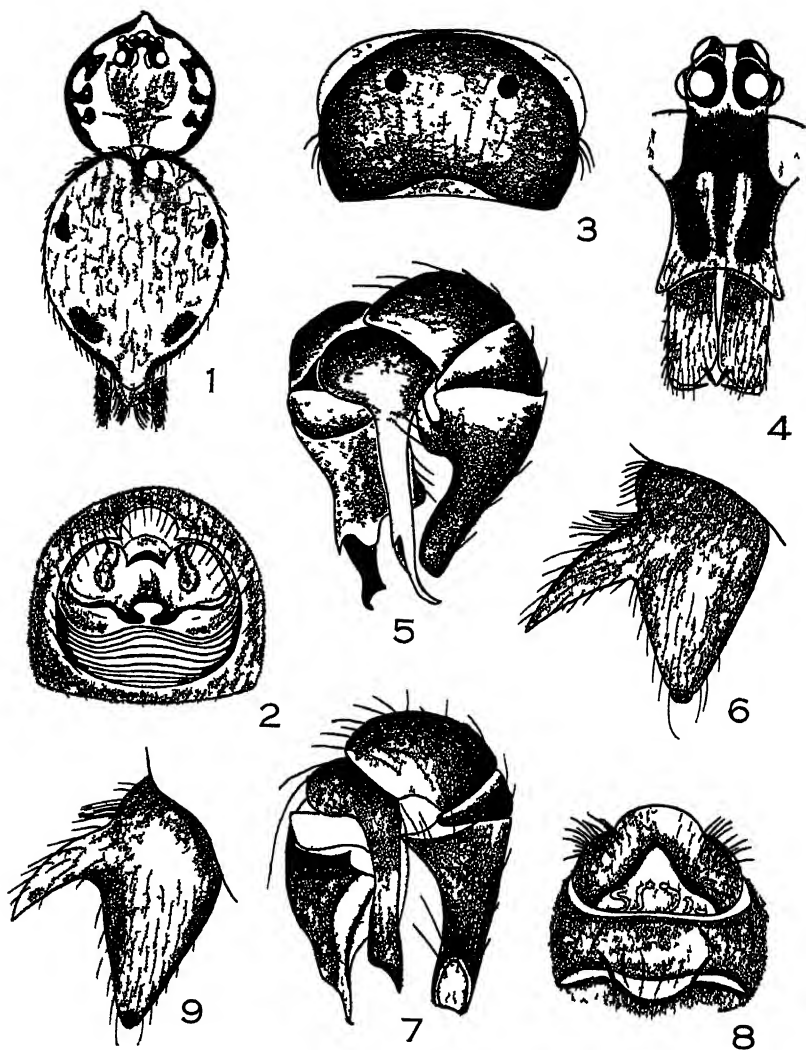
Carapace dull yellow to light brown in color, with a row of three black sub-marginal spots on each side of the pars thoracica, the area between them infuscated, the margins unmarked. Pars cephalica darkened, the eyes broadly ringed in black, the clypeus with a broad longitudinal dark band. Clothing of the carapace pale hairs. Sternum light brown, with a pale median stripe, clothed sparsely with erect hairs. Legs dull yellow, clothed with rows of black hairs, the femora with numerous dark spots beneath, the tibiae with a basal and a terminal dark ring, the metatarsi with a narrow basal annulus.

Carapace suborbicular, much flattened, the median groove longitudinal, shallow, the pars cephalica elevated into a high eminence on which the eyes are located. Clypeus steeply declining, subvertical. Anterior median eyes missing. Eyes sub-equal in size, the anterior laterals separated by their diameter. Eyes of the posterior row straight, the medians separated by their diameter, a radius from the laterals. Dorsal eye quadrangle broader than long (22/20), slightly wider in front (22/21). Clypeus equal in height to about seven times the diameter of an anterior lateral eye. Sternum broader than long, subquadrangular, broadly truncated between the posterior coxae which are separated by a little more than their length. Legs long and slender, the lengths of the joints of the first one as follows: femur, 3.70 mm., patella, 0.30 mm., tibia, 3.60 mm., metatarsus, 6.00 mm., and tarsus, 0.80 mm. long. Abdomen globose, dull gray, with a dorsal pattern of small black spots, the venter pale except for a small black spot behind the epigynum. Epigynum as illustrated in Fig. 3.

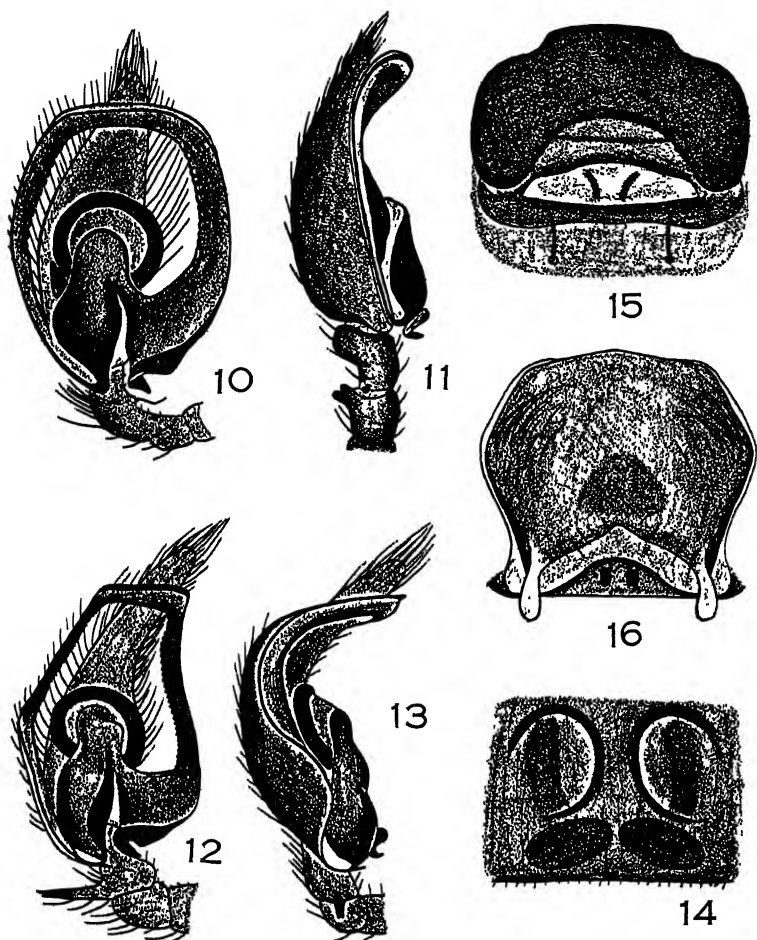
MALE.—Total length, 1.85 mm.

Color pattern and general structure in close agreement with the female, the markings on the legs, however, nearly obsolete. Carapace broader than long, the cephalic portion strongly elevated as in the female (Fig. 4). Chelicera curved, incrassated at the middle at which point is a patch of ten or twelve short setae. Distal end of the chelicera with six setae on the outer side in front and the usual short spine on the inner side. Palpus as shown in Fig. 5.

TYPE LOCALITY.—Male holotype, female allotype and paratype from sixty-two miles north of Acapulco, Guerrero, July 18, 1936 (A. M.



- Fig 1. *Oecobius beatus*, new species, dorsum of female, appendages omitted
 Fig 2. Idem, epigynum of female
 Fig 3. *Modisumus guerrerensis*, new species, epigynum of female.
 Fig 4. Idem, frontal view of male
 Fig 5. Idem, left palpus of male, retrolateral view.
 Fig 6. *Psilochorus cambridgei*, new species, left chelicera of male, retrolateral view.
 Fig 7. Idem, left palpus of male, retrolateral view.
 Fig 8. Idem, epigynum of female.
 Fig 9. *Psilochorus durangoanus*, new species, left chelicera of male, retrolateral view.



- Fig. 10. *Dictyna guerrenensis*, new species, left palpus of male, ventral view.
 Fig. 11. Idem, left palpus of male, retrolateral view.
 Fig. 12. *Dictyna incredula*, new species, left palpus of male, ventral view.
 Fig. 13. Idem, left palpus of male, retrolateral view.
 Fig. 14. Idem, epigynum of female.
 Fig. 15. *Psilochorus durangoanus*, new species, epigynum of female.
 Fig. 16. *Psilochorus coahuilanus*, new species, epigynum of female.

and L. I. Davis). Immature male and female paratypes from Jacala, Hidalgo, June 13, 1936 (Davis).

This species is distinct from *Modisimus maculatipes* Cambridge in having the ocular turret proportionately much higher and in the longer legs.

***Psilochorus cambridgei*, new species**

Figures 6, 7, and 8

FEMALE.—Total length, 2.50 mm.

	CARAPACE	FRONT	STERNUM	LABIUM	MAXILLA	ABDOMEN
Length	1.00	0.60	0.66	0.14	0.26	1.65 mm.
Width	0.96	0.50	0.75	0.26	0.14	1.45 mm.

Integument of the carapace dull yellow, the pars cephalica lightly infuscated, the median and cephalic grooves darkened to form a Y-shaped figure, the eyes ringed with black. Margins of the pars thoracica with a row of black spines, otherwise relatively smooth, the pars cephalica sparsely provided with black spines. Sternum and mouth parts concolorous with the carapace, set with a few long erect hairs and a thin covering of procumbent hairs. Appendages dull yellow, the femora with indistinct terminal annulae, the legs clothed evenly with black hairs.

Carapace slightly longer than broad, suborbicular, moderately convex, the cephalic portion elevated and rounded as usual, the median groove deep, longitudinal. Clypeus equal in height to four times the diameter of an anterior lateral eye (42/10). Ratio of the eyes: ALE:AME:PLE:PME = 10:6:10:10. Eyes of the first row procurved, the upper edges forming a slightly procurved line, the medians subcontiguous, contiguous with the larger laterals. Second row of eyes very weakly recurved, essentially straight, the medians separated by their diameter, contiguous with the laterals. Median ocular quadrangle broader than long (28/18), narrowed in front (28/14), the anterior medians much smaller. Sternum broader than long, subtruncate in front, rounded on the sides, truncated behind where the posterior coxae are separated by their length.

Legs moderately long, slender, the length of the joints of the first leg as follows: femur, 3.70 mm., patella, 0.30 mm., tibia, 3.50 mm., metatarsus, 4.00 mm., and tarsus, 1.10 mm.

Abdomen globose, gray in color, with small white flecks showing through the integument, clothed with black hairs. Epigynum as illustrated in Fig. 8, consisting of a subtriangular, chitinized plate on each side of which is a patch of erect black hairs. Just caudad of the sclerotized plate are two erect black spines, one on each side.

MALE.—Total length, 2.25 mm.

	CARAPACE	FRONT	STERNUM	LABIUM	MAXILLA	ABDOMEN
Length	1.00	0.60	0.60	0.12	0.24	1.30 mm.
Width	1.00	0.50	0.80	0.24	0.15	1.00 mm.

Color and structure in nearly complete agreement with the female. Clypeus sloping forward, equal in height to four times the diameter of an anterior lateral eye (38/10). Posterior median eyes separated by their full diameter. Relations of the eyes as in the female, the eyes of the first row very slightly more procurved. Chelicera armed as usual in males of the genus with a stout horn or spur (Fig. 6) which originates near the middle of the chelicera. As seen from in front the spur is very weakly incurved; from the side it is seen to be directed slightly forward and downward. Position, length, and details of the cheliceral spur in close agreement with the male of *Psilochorus pulchulus* (Hentz) and *P. utahensis* Chamberlin.

Legs proportionately longer and more slender than in the female, the lengths of the joints of the first leg as follows: femur, 4.50 mm., patella, 0.40 mm., tibia, 4.50 mm., metatarsus, 5.30 mm., and tarsus, 1.10 mm. Palpus as illustrated in Fig. 7.

TYPE LOCALITY.—Female holotype, male allotype, and five immature paratypes from five miles west of Saltillo, Coahuila, July 5, 1936 (Davis). Female paratype from twenty-five miles west of Monterrey, Nuevo Leon, July 6, 1936 (Davis).

Psilochorus durangoanus, new species

Figures 9 and 15

FEMALE.—Total length, 2.30 mm.

	CARAPACE	FRONT	STERNUM	LABIUM	MAXILLA	ABDOMEN
Length	0.90	0.53	0.56	0.10	0.25	1.70 mm.
Width	0.90	0.42	0.70	0.20	0.18	1.50 mm.

Integument of the carapace dull yellow, the median groove and cephalic sutures infuscated, the eyes ringed with black, the clypeus with a longitudinal dark band nearly as wide as the eye group. Sternum pale orange to brown. Mouth parts, chelicera, and appendages dull yellow, the legs marked with a distal annulus on the femora and basal and distal black rings on the tibiae.

Carapace as long as broad, moderately convex, the pars cephalica elevated and rounded, the structure in essential agreement with the female of *cambridgei*. Ratio of the eyes: ALE:AME:PLE:PME = 10:5:10:9. First row of eyes procurved as seen from in front, the upper edges of the eyes forming a weakly procurved line, the medians separated by one-third their diameter, subcontiguous with the laterals. Second row of eyes very weakly recurved, essentially straight, the medians separated by their diameter, contiguous with the laterals. Median ocular quadrangle broader than long (26/20), narrowed in front (26/13). Sternum broader than long, subtruncated between the posterior coxae which are separated by their length.

Legs moderately long, slender, the lengths of the joints of the first leg as follows: femur, 3.00 mm., patella, 0.35 mm., tibia, 3.25 mm., metatarsus, 4.00 mm., and tarsus, 0.70 mm.

Abdomen subglobose, bluish gray, with small white spots showing through the integument, clothed with black hairs. Epigynum as illustrated in Fig. 15.

MALE.—Total length, 2.65 mm.

	CARAPACE	FRONT	STERNUM	LABIUM	MAXILLA	ABDOMEN
Length	1.10	0.70	0.58	0.13	0.26	1.60 mm.
Width	1.05	0.50	0.77	0.24	0.15	1.20 mm.

Color and structure nearly as in the female. Cheliceral horn as illustrated in Fig. 9, somewhat shorter than in *P. cambridgei*, new species, but originating in nearly the same position. As seen from in front the horn is very weakly incurved.

Legs moderately long, the lengths of the joints of the first one as follows: femur, 4.35 mm., patella, 0.35 mm., tibia, 4.50 mm., metatarsus, 5.50 mm., and tarsus, 1.10 mm. Palpus in close agreement with that of *P. pullulus* and *utahensis*.

TYPE LOCALITY.—Female holotype and male allotype from Lerdo, Durango, July 4, 1936 (Davis). Female and two immature paratypes from one mile west of Lerdo, July 4, 1936 (Davis).

This species is rather closely allied to *Psilochorus utahensis* Chamberlin but is distinct in the much shorter, straighter horns on the chelicerae of the male, in having a basal dark annulus on the tibiae, and in the details of the epigynal ridges of the female.

Psilochorus coahuilanus, new species

Figure 16

FEMALE.—Total length, 2.30 mm.

	CARAPACE	FRONT	STERNUM	LABIUM	MAXILLA	ABDOMEN
Length	1.00	0.55	0.60	0.15	0.25	1.40 mm.
Width	0.90	0.50	0.75	0.25	0.19	1.10 mm.

Integument of the carapace pale yellow, the median groove and cephalic furrows darkened to form a Y-shaped figure, the eyes ringed with black. Clothing of the carapace a few black hairs, the pars thoracica with a marginal row present, the pars cephalica with several behind the ocular area. Sternum and mouth parts pale yellow, unmarked, clothed with a few erect black hairs which are interspersed with a thicker covering of shorter procumbent hairs. Legs concolorous with the carapace, unmarked except for faint narrow annulae on the femora and tibiae, clothed with rows of black hairs.

Carapace slightly longer than broad, suborbicular in outline, the pars thoracica relatively low and moderately convex, the pars cephalica strongly elevated and rounded. Eyes of the first row procurved, the upper edges of the eyes forming a straight line, the medians separated by scarcely their radius, slightly nearer the laterals. Ratio of the eyes: ALE:AME:PLE:PME = 10:5:9:9.5. Second row of eyes very weakly recurved, essentially straight, the medians separated by more than a diameter (12/9), contiguous with the subequal laterals. Median ocular quadrangle broader than long (28/17), narrowed in front (28/12), the anterior medians much smaller. Clypeus equal in height to scarcely four diameters of an anterior lateral eye (38/10). Sternum broader than long, subtruncate in front, rounded on the sides, truncated between the posterior coxae which are separated by their width.

Legs long and slender as usual, the lengths of the joints of the first one as follows: femur, 4.00 mm., patella, 0.35 mm., tibia, 4.30 mm., metatarsus, 5.00 mm., and tarsus, 1.20 mm.

Abdomen elevated, globose, subtriangular in outline as seen from the side, with a pattern of small round white spots which show through the gray integument. Epigynum ridges prominent (see Fig. 16), the area larger than usual in the genus, the caudal end of the plate with a small spatuliform process on each side and a patch of long black hairs on each side near the middle.

TYPE LOCALITY.—Female holotype and female paratype from twenty miles east of San Pedro, Coahuila, Mexico, July 5, 1936 (A. M. and L. I. Davis).

Psilochorus utahensis Chamberlin

Psilochorus utahensis CHAMBERLIN, 1919, Ann. Ent. Soc. America, XII, p. 247, Pl. xvii, fig. 2.

RECORD.—Hidalgo: Sixty miles south of Jacala, July 1, 1936, male and female (L. I. Davis).

Mimetidae

Mimetus hesperus Chamberlin

Mimetus hesperus CHAMBERLIN, 1923, Journ. Ent. Zool., Pomona College, XV, p. 5, Figs. 2 and 7.

RECORD.—Nuevo Leon: Monterrey, June 10, 1936, immature female (Davis).

Uloboridae

Uloborus variegatus Cambridge

Uloborus variegatus CAMBRIDGE, 1898, 'Biol. Centr. Amer.,' I, p. 266, Pl. xxxviii, fig. 11.

RECORDS.—Guerrero: sixty-two miles north of Acapulco, June 18, 1936, males and females (A. M. and L. I. Davis). Tamaulipas: seven miles south of Hidalgo, July 3, 1936, two males, immature female (Davis).

Uloborus signatus Cambridge

Uloborus signatus CAMBRIDGE, 1898, 'Biol. Centr. Amer.,' I, p. 264, Pl. xxxviii, figs. 9 and 10.

RECORDS.—Vera Cruz: Potrero, June 24, 1936, male and female (Davis). San Luis Potosi: Five miles north of Tamazunchale, July 2, 1936 (A. M. and L. I. Davis).

Uloborus americanus Walckenaer

Uloborus americanus WALCKENAER, 1842, 'Ins. Apt.,' II, p. 229.

RECORDS.—Durango: Lerdo, July 4, 1936, three females (Davis). Tamaulipas: Victoria, June 12, 1936, female (Davis).

Dictynidae

Mallos niveus Cambridge

Mallos niveus CAMBRIDGE, 1902, 'Biol. Centr. Amer.,' I, p. 308, Pl. xxxv, fig. 1.

RECORDS.—Nuevo Leon: Horsetail Falls, June 11, 1936, male and female (A. M. and L. I. Davis). Morelos: Cuernavaca, June 20, 1936, immature examples (Davis).

Dictyna grandis Cambridge

Dictyna grandis CAMBRIDGE, 1896, 'Biol. Centr. Amer.,' I, p. 172, Pl. xxi, fig. 4.

RECORD.—Hidalgo: Jacala, June 13, 1936, immature examples apparently this species (Davis).

Dictyna iviei Gertsch and Mulaik

Dictyna iviei GERTSCH AND MULAİK, 1936, American Mus. Novitates, No. 851, p. 7, Figs. 6 and 7.

RECORD.—Nuevo Leon: fifty-four miles south of Laredo, Texas, July 7, 1936, two immature males (Davis).

Dictyna mulegensis Chamberlin

Dictyna mulegensis CHAMBERLIN, 1924, Proc. California Acad. Sci., (4) XII, p. 582, Figs. 7, 8, and 9.

RECORDS.—Durango: Lerdo, July 4, 1936, female (Davis). Tamaulipas: San Fernando, March 28, 1937, male, females (Davis). Arroyo La Chorrera, March 28, 1937, female (A. M. and L. I. Davis).

Dictyna guerrenderensis, new species

Figures 10 and 11

MALE.—Total length, 1.40 mm.

	CARAPACE	FRONT	STERNUM	LABIUM	MAXILLA	ABDOMEN
Length	0.62	0.20	0.40	0.15	0.19	0.80 mm.
Width	0.55	0.28	0.37	0.16	0.13	0.60 mm.

Carapace brown in color, darker on the sides of the head, with dark radiating streaks on the pars thoracica. Clothing white hairs which are more numerous and longer around the eyes and on the clypeus. Carapace rounded on the sides, convex, strongly elevated in front, the highest point just behind the ocular area, the median groove obsolete. Eyes of the first row weakly procurved, the medians separated by the radius, scarcely as far from the larger laterals. Ratio of the eyes: ALE:AME:PLE:PME = 5.5:4:5:5.5. Eyes of the second row slightly recurved, the broadly oval medians separated by their short diameter (5/5), as far from the subequal laterals. Median ocular quadrangle broader than long (14/12), narrowed in front in the same ratio. Clypeus equal in height to more than the diameter of an anterior median eye (6.5/4). Sternum and maxillae pale brown, the labium darker brown, all sparsely clothed with black hairs.

Legs pale yellow, without markings, clothed with rows of pale hairs. First leg: femur, 0.60 mm., patella, 0.18 mm., tibia, 0.53 mm., metatarsus, 0.42 mm., and tarsus, 0.30 mm. long. Palpus as illustrated in Figs. 10 and 11.

Abdomen pale, dusky brown, with a small basal black dash and with broken black chevrons in the caudal half, the venter paler.

TYPE LOCALITY.—Male holotype from sixty-two miles north of Acapulco, Guerrero, June 18, 1936 (A. M. and L. I. Davis).

The palpus of this species has considerable resemblance to that of *Dictyna miniata* Banks described from Mexico. However, the great difference in size and the details of the apophyses of the male palpus will serve to separate the two species.

Dictyna incredula, new species

Figures 12, 13, and 14

MALE.—Total length, 1.28 mm.

	CARAPACE	FRONT	STERNUM	LABIUM	MAXILLA	ABDOMEN
Length	0.60	0.20	0.33	0.13	0.19	0.75 mm.
Width	0.47	0.25	0.33	0.14	0.10	0.50 mm.

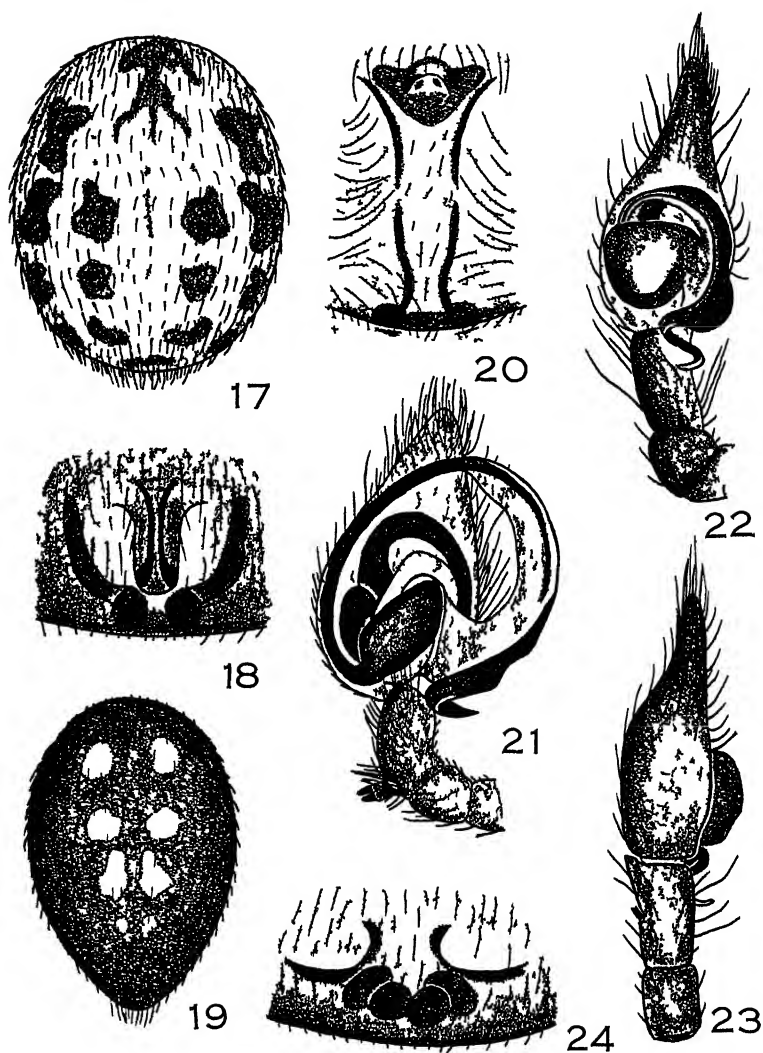
Carapace yellowish brown, darkened on the sides of the head and showing a faint dark marginal seam and radiating darker streaks on the pars thoracica. Integument sparsely supplied with white hairs, those on the pars cephalica longer and more numerous. Pars cephalica strongly elevated, convex, highest behind the eye group, steeply declining on the sides and behind, the clypeus concave, slightly protruding. Pars thoracica essentially round, weakly convex. Eyes of the first row very gently procurved, essentially straight, the medians separated by the radius, scarcely as far from the larger laterals. Ratio of the eyes: ALE:AME:PLE:PME = 7:4.5:6:5. Clypeus equal in height to twice the diameter of an anterior median eye (4.5/9). Second row of eyes slightly recurved, the medians separated by four-fifths their diameter, a full diameter from the subequal lateral eyes. Median ocular quadrangle broader than long (15/12), narrowed in front in the same ratio. Sternum, labium, and maxillae dusky brown, sparsely clothed with inconspicuous hairs. Chelicerae brown, with a slight tooth near the base. Abdomen mainly dusky, with a pale median figure in the caudal half.

Legs uniform pale yellow, without markings, clothed evenly with rows of black hairs. First leg: femur, 0.50 mm., patella, 0.15 mm., tibia, 0.48 mm., metatarsus, 0.36 mm., and tarsus, 0.27 mm. long. Palpus as illustrated in Figs. 12 and 13.

FEMALE.—Total length, 1.40 mm.

Color pattern in nearly complete agreement with the male but the maculations on the abdomen more clearly defined because of its greater size. Pars cephalica much lower, more evenly convex, as usual in females of the genus. Eyes agreeing closely in size and arrangement with the male. Epigynum as in Fig. 14.

TYPE LOCALITY.—Male holotype, female allotype, and paratype from five miles north of Tamazunchale, San Luis Potosi, July 2, 1936 (A. M. and L. I. Davis).



- Fig 17 *Dictyna spatula*, new species, dorsum of female abdomen
 Fig 18 Idem, epigynum of female
 Fig 19 *Dictyna octomaculella*, new species, dorsum of female abdomen
 Fig 20 Idem, epigynum of female
 Fig 21 *Dictyna puebla*, new species, left palp of male, ventral view
 Fig 22 *Dictyna jacalana*, new species, left palp of male, ventral view.
 Fig 23 Idem, left palp of male, subdorsal view
 Fig 24 Idem epigynum of female

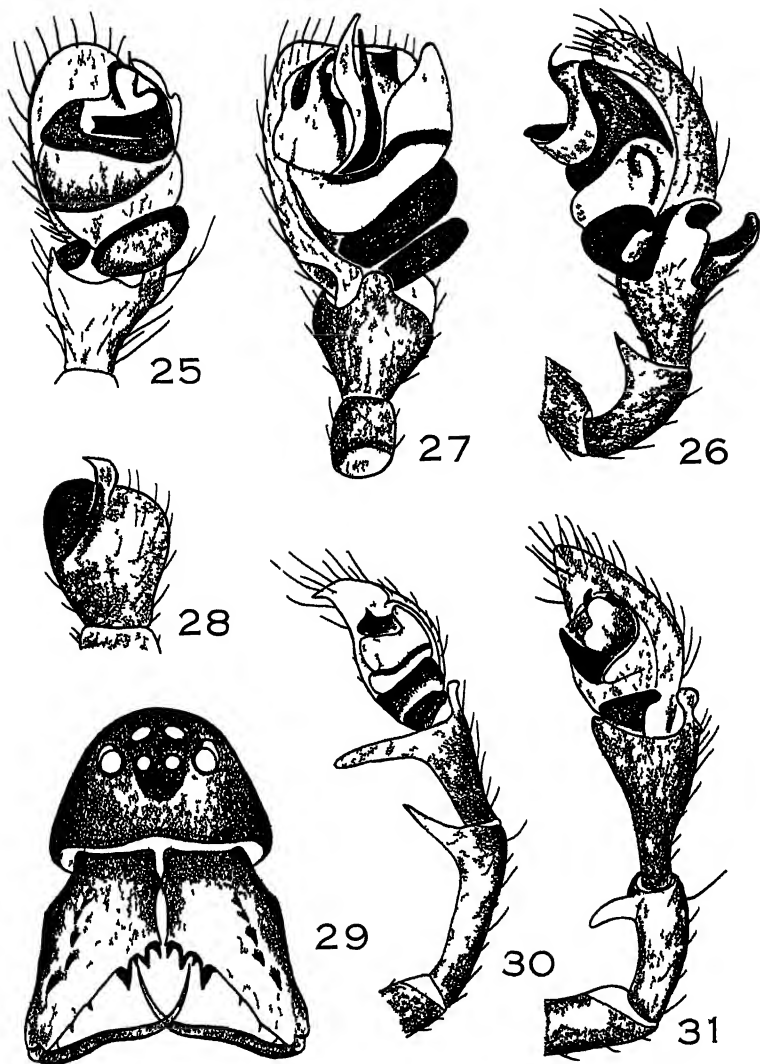


Fig 25 *Erigone tamazunchalensis*, new species, left palpus of male, ventral view

Fig 26 Idem, left palpus of male, retrolateral view

Fig 27 *Eulaira hidalgoana*, new species, left palpus of male, ventral view

Fig 28 Idem, tibia of left palpus of male, dorsal view

Fig 29 *Erigone monterreyensis*, new species, frontal view of male

Fig 30 Idem, left palpus of male, subventral view

Fig 31 *Erigone tolucana*, new species, left palpus of male, subventral view

Dictyna spatula, new species

Figures 17 and 18

FEMALE.—Total length, 2.15 mm.

	CARAPACE	FRONT	STERNUM	LABIUM	MAXILLA	ABDOMEN
Length	0.81	0.20	0.52	0.18	0.25	1.50 mm.
Width	0.61	0.37	0.42	0.18	0.11	1.10 mm.

Clothing of the carapace sparse, the head portion with a few long pale hairs and the clypeal margin with three very weak spines. Carapace dark brown, darker on the sides of the head, the pars thoracica with darker radiating streaks. Pars thoracica as seen from above suborbicular, the sides gently rounded, the caudal margin emarginated; as seen from the side much lower and less convex than the rounded, elevated pars cephalica. Clypeus subvertical, 0.80 mm. high. Chelicerae dark brown, subparallel, the inner margins very shallowly excavated. Sternum dull yellow, dusky at the margins, clothed with erect black hairs; labium dusky; maxillae dull yellow. Coxae and legs dull yellow, unmarked, clothed with black hairs. Abdomen pale gray to white, the dorsum with a pattern of black markings as illustrated in Fig. 17.

Ratio of the eyes: ALE:AME:PLE:PME = 7:5:7:7. Eyes of the first row straight, the medians separated by four-fifths their diameter, half as far from the lateral eyes. Second row of eyes moderately recurved, the medians separated by two-thirds their diameter (4/7), as far from the lateral eyes. Median ocular quadrangle broader than long (16/14), narrowed in front in the same ratio.

First leg: femur, 0.63 mm., patella, 0.24 mm., tibia, 0.53 mm., metatarsus, 0.46 mm., and tarsus, 0.30 mm. long. Epigynum as illustrated in Fig. 18, characterized by the presence of a spatuliform scape which is traversed by two black tubes.

TYPE LOCALITY.—Female holotype from Acapulco, Guerrero, June 17, 1936 (L. I. Davis).

Dictyna octomaculella, new species

Figures 19 and 20

FEMALE.—Total length, 1.95 mm.

	CARAPACE	FRONT	STERNUM	LABIUM	MAXILLA	ABDOMEN
Length	0.75	0.23	0.45	0.14	0.21	1.30 mm.
Width	0.67	0.35	0.48	0.18	0.14	1.00 mm.

Carapace light reddish brown, darkened somewhat and with darker radiating streaks on the pars thoracica, the eyes narrowly ringed in black. Pars cephalica rather thickly covered with gray hairs, the remainder of the carapace more sparsely clothed. Carapace longer than broad, the pars thoracica suborbicular, convex, lower than the rounded pars cephalica. Sternum cordate, dull orange-brown in color, slightly broader than long, bluntly rounded behind where the fourth coxae are separated by their length, clothed evenly with black hairs. Labium concolorous, broader than long, subtriangular, rounded distally, clothed with black hairs. Maxillae somewhat convergent distally, concolorous with the labium and sternum, short

and relatively heavy, slightly excavated on the inner sides. Legs dusky brown, the distal joints paler. Abdomen ovate, nearly black, with a pattern of four pairs of white spots above as shown in Fig. 19, the posterior three pairs nearly coalesced. Venter gray.

Ratio of the eyes: ALE:AME:PLE:PME = 5:4.5:4.5:5. First row of eyes very weakly procurved, essentially straight, the medians separated by their diameter, a radius from the laterals. Clypeus equal in height to more than three diameters of an anterior median eye (4/14). Second row of eyes weakly recurved, the medians separated by more than a diameter (7/5), a diameter from the laterals (5/5). Median ocular quadrangle broader than long (15/12), slightly narrowed in front (15/13.5).

Legs without spines, evenly clothed with rows of black hairs. First leg: femur, 0.70 mm., patella, 0.22 mm., tibia, 0.55 mm., metatarsus, 0.46 mm., and tarsus, 0.34 mm. long. Epigynum as illustrated in Fig. 20.

TYPE LOCALITY.—Female holotype from five miles north of Tamaunchale, San Luis Potosi, July 2, 1936 (A. M. and L. I. Davis).

Dictyna reticulata Gertsch and Ivie

Dictyna reticulata GERTSCH AND IVIE, 1936, American Mus. Novitates, No. 858, p. 7, Fig. 27.

RECORDS.—Coahuila: San Pedro, July 5, 1936, female and immature examples (Davis). Durango: one mile west of Lerdo, July 4, 1936, male (Davis).

Dictyna calcarata Banks

Dictyna calcarata BANKS, 1904, Proc. California Acad. Sci., (3) III, p. 342, Pl. XI, fig. 42.

RECORD.—Nuevo Leon: Monterrey, June 10, 1936, three males, several females (Davis).

Dictyna idahoana Chamberlin and Ivie

Dictyna idahoana CHAMBERLIN AND IVIE, 1933, Bull. Univ. Utah, Biol., II, p. 4, Pl. I, figs. 1, 2, and 3.

RECORD.—Nuevo Leon: fifty-four miles south of Laredo, Texas, July 7, 1936, female (Davis).

Dictyna florens Ivie and Barrows

Dictyna florens IVIE AND BARROWS, 1935, Bull. Univ. Utah, Biol., III, p. 4, Pl. I, figs. 1-5.

RECORD.—Tamaulipas: Victoria, June 12, 1936, two females (Davis).

Dictyna foliacea (Hentz)

Theridion foliaceum HENTZ, 1850, Journ. Boston Soc. Nat. Hist., VI, p. 277, Pl. IX, fig. 14.

RECORD.—Nuevo Leon: Horsetail Falls, June 11, 1936, female (A. M. and L. I. Davis).

Dictyna jacalana, new species

Figures 22, 23, and 24

FEMALE.—Total length, 2.35 mm.

	CARAPACE	FRONT	STERNUM	LABIUM	MAXILLA	ABDOMEN
Length	0.95	0.20	0.63	0.22	0.30	1.50 mm.
Width	0.75	0.36	0.47	0.22	0.10	1.00 mm.

Carapace very dark brown, the head somewhat lighter above, with a marginal black seam, clothed with white scales which are concentrated on the pars cephalica. Chelicerae, sternum, and mouth parts dark brown, clothed with erect black hairs and a few white ones, these latter present particularly on the margins of the sternum. Legs yellow to light brown, the femora darker, due to black median and distal annulae which are coalesced on the first two pairs of legs; the other joints annulate as follows: the tibiae and metatarsi with subbasal and distal rings. Tibia of the palpus almost completely ringed with black. Clothing of the appendages rows of black hairs and scattered long white scales. Abdomen gray, the dorsum marked with a black basal rectangular bar which goes caudad to the middle and which is followed by a pale area flanked with black side bars. Venter lightly spotted with black. Abdomen evenly covered with subprocumbent hairs.

Coloration and structure in very close agreement with *Dictyna calcarata* Banks. Pars cephalica moderately elevated as usual in females of the genus, convex, higher than the suborbicular pars thoracica. Ratio of the eyes: ALE:AME:PLE:PME = 7:5:7:7. First row of eyes straight from in front, the medians separated by their diameter, three-fifths as far from the laterals. Second row of eyes straight, the medians separated by scarcely a diameter (7/6), slightly more than a diameter from the laterals (7/8). Median ocular quadrangle as long as broad (17/17), slightly narrowed in front (17/13). Clypeus equal in height to a diameter of an anterior median eye. First leg: femur, 1.00 mm., patella, 0.26 mm., tibia, 0.95 mm., metatarsus, 0.70 mm., and tarsus, 0.40 mm. long. Epigynum as illustrated in Fig. 24.

MALE.—Total length, 2.15 mm.

	CARAPACE	FRONT	STERNUM	LABIUM	MAXILLA	ABDOMEN
Length	1.16	0.22	0.64	0.25	0.35	1.40 mm.
Width	0.80	0.44	0.48	0.22	0.12	0.80 mm.

Color pattern in complete agreement with the female but the annulae on the appendages much less distinct. Carapace as usual in males of the genus, the pars cephalica much elevated and broadly rounded above, much higher than the thoracic portion. Eyes as in the female. Chelicera strongly bent, excavated on the inner side, with a weak, rounded spur near the base. First leg: femur, 1.25 mm., patella, 0.35 mm., tibia, 1.15 mm., metatarsus, 0.85 mm., and tarsus, 0.45 mm. long. Palpus as illustrated in Figs. 22 and 23.

TYPE LOCALITY.—Male holotype, female allotype, and paratype from Jacala, Hidalgo, June 13, 1936 (Davis).

This species agrees very well in color pattern with *Dictyna calcarata* Banks and is closely related structurally in the female. The male,

however, is quite radically different in palpal characters as illustrated in the figures.

Dictyna puebla, new species

Figure 21

MALE.—Total length, 3.05 mm.

	CARAPACE	FRONT	STERNUM	LABIUM	MAXILLA	ABDOMEN
Length	1.25	0.28	0.75	0.30	0.45	1.75 mm.
Width	1.05	0.56	0.65	0.26	0.15	1.20 mm.

Carapace almost uniform dark brown, variegated with a forked black maculation at the cephalic sutures and black radiating lines from the median groove. Pars cephalica clothed with rows of long, subprocumbent white scales. Sternum brown, darkened on the margins, the maxillae brown, the labium darker brown, the under parts clothed sparsely with erect black and white hairs. Chelicerae nearly black. Legs brown, the femora nearly black, set with rows of black hairs. Abdomen brown to black, lightened above, the venter brown. Color pattern in close agreement with *Dictyna volucris* Keyserling.

Structure essentially as in males of *volucris* and related species. Pars thoracica suborbicular as seen from above, convex, much lower than the convex, elevated pars cephalica. Clypeus sloping, equal in height to three diameters of an anterior median eye. Ratio of the eyes: ALE:AME:PLE:PME = 8:6:8:8. First row of eyes very weakly procurved as seen from in front, essentially straight, the medians separated by more than a diameter (6/8), nearer the laterals (6/5). Eyes of the posterior row straight, the medians separated by more than a diameter (8/11), slightly nearer the laterals (8/10). Median ocular quadrangle broader than long (24/20), narrowed in front in the same ratio. Sternum subcordate, bluntly rounded behind, the fourth coxae separated by their width.

First leg: femur, 1.35 mm., patella, 0.37 mm., tibia, 1.06 mm., metatarsus, 0.80 mm., and tarsus, 0.50 mm. long. Palpus as illustrated in Fig. 21, the structure essentially as in *volucris* but distinct in the details of the conductor.

TYPE LOCALITY.—Male holotype from the Mountain Pass, Puebla, east of Mexico, D. F., June 20, 1936 (A. M. and L. I. Davis).

Micryphantidae

Eulaira suspecta Gertsch and Mulaik

Eulaira suspecta GERTSCH AND MULAİK, 1936, American Mus. Novitates, No. 863, p. 1, Figs. 1, 2, and 3.

RECORDS.—Nuevo Leon: Monterrey, June 10, 1936, two females (Davis). Tamaulipas: fifteen miles south of Victoria, June 2, 1936, male and two females (A. M. and L. I. Davis).

Eulaira hidalgoana, new species

Figures 27 and 28

MALE.—Total length, 1.05 mm.

	CARAPACE	FRONT	STERNUM	LABIUM	MAXILLA	ABDOMEN
Length	0.50	0.12	0.30	0.05	0.14	0.55 mm.
Width	0.38	0.24	0.28	0.09	0.11	0.35 mm.

Carapace dull yellow, lightly infuscated, the eyes ringed with black and enclosing a black field. Sternum dull yellow, infuscated, with a very few erect black hairs. Mouth parts dull yellow. Legs concolorous with the carapace, set with rows of weak black hairs. Abdomen gray, lightly infuscated.

Carapace suboval, broadly rounded in front, convex, the pars cephalica highest just behind the eyes, subhorizontal caudal to the obsolete median groove, the posterior declivity evenly declining to the margins. Clypeus equal in height to three diameters of an anterior median eye. Ratio of the eyes: ALE:AME:PLE:PME = 4.5:2.5:4:4. First row of eyes straight, subcontiguous. Second row of eyes very weakly recurved, essentially straight, the medians separated by their radius, slightly nearer the laterals. Median ocular quadrangle broader than long (10/9), narrowed in front (10/6). Sternum truncate in front, gently rounded on the sides, truncated between the posterior coxae which are separated by their length. Legs of average length, the tibia and patella of the first leg, 0.43 mm. long. Palpus as illustrated in Fig. 27 and Fig. 28.

TYPE LOCALITY.—Male holotype from Tepeji, Hidalgo, June 13, 1936 (A. M. and L. I. Davis).

Erigone monterreyensis, new species

Figures 29 and 30

MALE.—Total length, 1.49 mm.

	CARAPACE	FRONT	STERNUM	LABIUM	MAXILLA	ABDOMEN
Length	0.77	0.20	0.40	0.09	0.23	0.80 mm.
Width	0.58	0.38	0.43	0.11	0.25	0.53 mm.

Carapace bright yellow to orange, tinged slightly with dusky along the side margins and at the position of the median groove, the eye tubercles black. Sternum dusky over a pale yellow ground. Labium and maxillae orange, the coxae slightly paler, the whole ventral surface very sparsely set with erect black hairs. Chelicerae bright orange, the teeth brown. Palpi bright orange, the legs somewhat paler unmarked, set with rows of black hairs. Abdomen gray above, more dusky beneath.

Carapace oval in outline, broadly rounded in front and behind, the pars thoracica moderately convex, the pars cephalica broad in front, elevated, more strongly convex, the cephalic sutures poorly indicated, the median groove a faint linear suture. Clypeus sloping, equal in height to three and one-half diameters of an anterior median eye. Ratio of the eyes: ALE:AME:PLE:PME = 6:4:5:5. Eyes of the first row in a procurved line, the upper edges forming a very weakly procurved line the medians separated by one-half their radius, about as far from the laterals. Sec-

and row of eyes slightly wider than the first, straight, the medians separated by three-fifths their diameter, as far from the laterals. Median ocular quadrangle broader than long (14/12), narrowed in front (14/10). Sternum broad, the anterior margin slanting forward to the labium, narrowly truncated there, the posterior portion bluntly pointed, the posterior coxae separated by scarcely their width. Endites very large, converging anteriorly so as nearly to enclose the labium, very broad at the base. Chelicerae large, strongly divaricate, the claw long and sinuous, the frontal margin with a row of five or six teeth. Upper margin of the furrow with four, the lower with six teeth. Details of the chelicerae as illustrated in Fig. 29. Outer side of the chelicera with coarse stridulating ridges. Palpus as illustrated in Fig. 30. Femur of the palpus with three small cusps or teeth near the base on the prolateral side which touch the stridulating ridges. Patellar spur as in *barrowsi*, the tibial spur more strongly curved than in that species.

TYPE LOCALITY.—Male holotype and two male paratypes from Monterrey, Nuevo Leon, June 10, 1936 (L. I. Davis).

This interesting species is related to *Erigone barrowsi* Crosby and Bishop but is somewhat larger in size, has the chelicerae more strongly divaricate and spined, and differs in the details of the palpus.

Erigone barrowsi Crosby and Bishop

Erigone barrowsi CROSBY AND BISHOP, 1928, Bull. New York State Museum, No. 278, p. 21, Pl. II, figs. 21-24.

RECORD.—Vera Cruz: Potrero, June 24, 1936, male (Davis).

Erigone dentosa Cambridge

Erigone dentosa CAMBRIDGE, 1894, Biol. Centr. Amer., I, p. 128, Pl. XVI, fig. 1.

RECORD.—Mexico: Crater of Mount Toluca, June 28, 1936, males and females (A. M. and L. I. Davis).

Erigone tolucana, new species

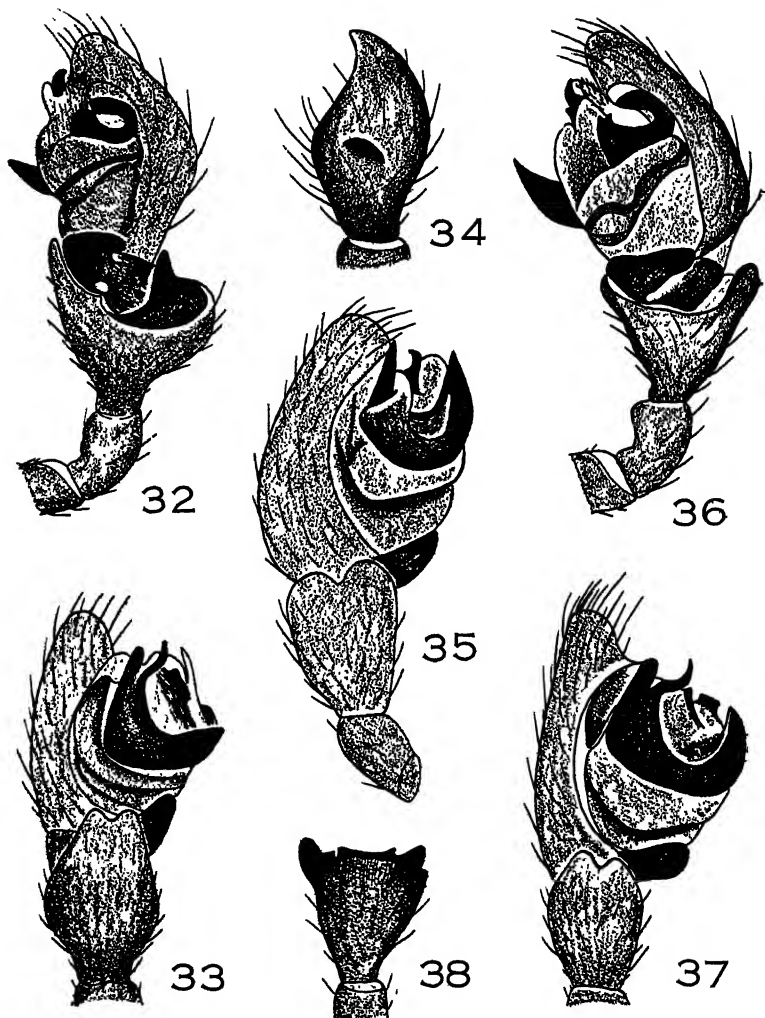
Figures 31 and 44

MALE.—Total length, 2.40 mm.

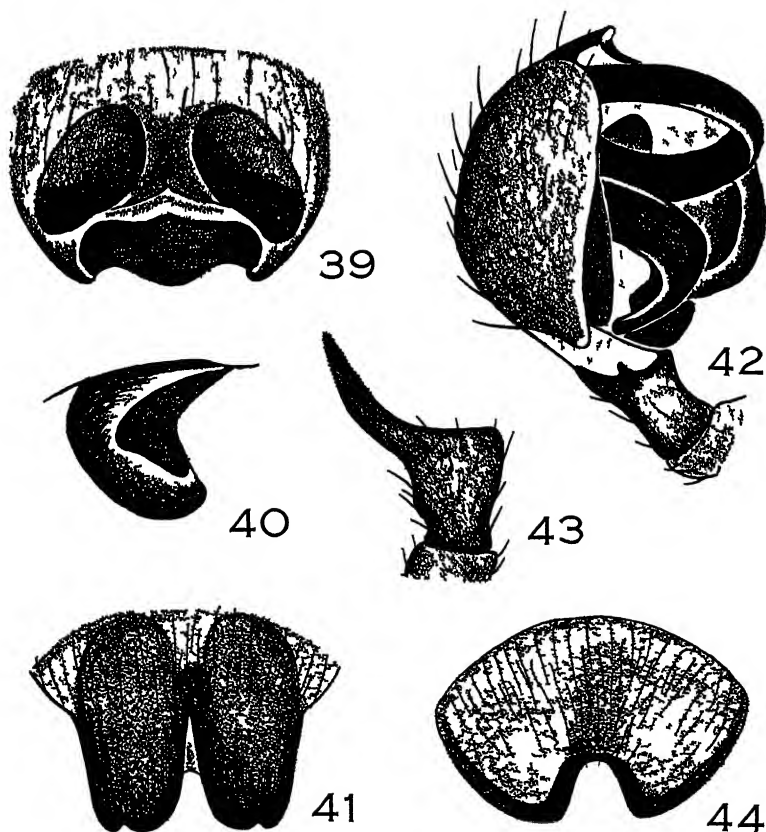
	CARAPACE	FRONT	STERNUM	LABIUM	MAXILLA	ABDOMEN
Length	1.17	0.30	0.60	0.14	0.32	1.35 mm.
Width	0.87	0.54	0.65	0.18	0.28	0.80 mm.

Carapace dark brown, smooth, marked with radiating black streaks and with a small dark figure just in front of the black median groove. Sternum and labium nearly black, the endites paler, set with a few inconspicuous erect black hairs. Chelicerae dark brown. Palpi and legs light brown, clothed with rows of black hairs. Abdomen uniform black.

Carapace as seen from above a long oval, somewhat narrowed in front but broadly rounded there and on the caudal margin. Pars thoracica convex, the median groove distinct, longitudinal, the cephalic sutures obsolete, the pars cephalica some-



- Fig. 32. *Eperigone agressa*, new species, left palpus of male, prolateral view.
 Fig. 33. Idem, left palpus of male, retrolateral view.
 Fig. 34. *Eperigone annamae*, new species, tibia of left male palpus, dorsal view
 Fig. 35. Idem, left palpus of male, prolateral view.
 Fig. 36. *Eperigone tepejicana*, new species, left palpus of male, prolateral view.
 Fig. 37. Idem, left palpus of male, retrolateral view.
 Fig. 38. Idem, tibia of left palpus of male, dorsal view.



- Fig 39 *Eperigone tlaxcalana*, new species, epigynum of female, ventral view
 Fig 40 Idem, epigynum of female, lateral view
 Fig 41 *Eperigone agressa*, new species, epigynum of female, ventral view
 Fig 42 *Ceratinopsis guerrerensis*, new species, left palpus of male, prolateral view
 Fig 43 Idem, tibia of left palpus of male, dorsal view
 Fig 44 *Erigone tolucana*, new species, epigynum of female

what higher and more convex. Carapace as seen from the side highest just behind the ocular area, rather evenly declining caudally to the margin. Clypeus subvertical, equal in height to three diameters of an anterior median eye. Ratio of the eyes: ALE:AME:PLE:PME = 7:5:6:6. First row of eyes essentially straight, the medians separated by about the radius, nearly a diameter from the laterals. Second row of eyes slightly broader than the first, straight, the medians separated by the diameter, scarcely as far from the laterals. Median ocular quadrangle broader than long (17/16), narrowed in front (17/12). Sternum broader than long, subtruncated in front, narrowly truncated behind, the posterior coxae separated by two-thirds their length. Maxillae large, with a small hook near the outer margin at the distal end. Chelicerae vertical, relatively large, the fang slightly curved, average in size. Anterior surface of the chelicera with a very stout tooth or spur near the inner side below the middle and a row of eight teeth near the outer margin. Upper margin of the furrow of the chelicera with five teeth, the lower with four. Palpus as illustrated in Fig. 31. Femur curved, with a small cusp on the prolateral side near the base and four well-separated weak cusps on the ventral surface. Patella with a stout apophysis. Tibia lacking the usual apophysis present in members of the genus.

FEMALE.—Total length, 2.95 mm.

	CARAPACE	FRONT	STERNUM	LABIUM	MAXILLA	ABDOMEN
Length	1.15	0.30	0.63	0.11	0.28	1.75 mm.
Width	0.80	0.60	0.63	0.22	0.20	1.30 mm.

Color essentially as in the male. Clypeus equal in height to three diameters of an anterior median eye. Eyes of the first row straight, the medians separated by a radius, scarcely a diameter from the larger laterals. Second row of eyes straight, equal in size, subequidistantly spaced a diameter apart. Median ocular quadrangle as broad as long, narrowed in front (17/11). Chelicera with five teeth on the upper margin, four on the lower, the two near the base of the fang coalesced. Epigynum as illustrated in Fig. 44.

TYPE LOCALITY.—Male holotype, two male paratypes, female allotype, and five female paratypes from the Crater of Mount Toluca, Mexico, June 28, 1936 (A. M. and L. I. Davis).

Erigone tamazunchalensis, new species

Figures 25 and 36

MALE.—Total length, 1.30 mm.

	CARAPACE	FRONT	STERNUM	LABIUM	MAXILLA	ABDOMEN
Length	0.64	0.16	0.34	0.07	0.20	0.66 mm.
Width	0.50	0.35	0.34	0.10	0.15	0.45 mm.

Carapace pale yellow to yellowish brown, the eyes narrowly ringed with black, essentially smooth, provided only with a few weak hairs on the clypeus and two erect hairs behind on the mid-line. Under side concolorous with the dorsum, set with fine black hairs. Legs pale yellow, clothed with rows of fine black hairs. Abdomen gray, evenly covered with fine black hairs.

Carapace broadly oval in outline, the front gently rounded, broad, the pars cephalica convex, higher than the pars thoracica, evenly declining caudally as seen from the side to the margin. Median suture short, an indistinct longitudinal line. Ratio of the eyes: ALE:AME:PLE:PME = 6:3:6:6. Eyes of the first row in a weakly procurved line, the upper edges forming a straight line, the medians subcontiguous, separated by one-third their diameter from the much larger laterals. Clypeus equal in height to three diameters of an anterior median eye. Posterior row of eyes very gently recurved, essentially straight, the medians separated by their radius, slightly nearer the laterals. Median ocular quadrangle broader than long (12/10), narrowed in front (12/7). Sternum subcordate, as broad as long, subtruncated in front, bluntly pointed between the posterior coxae which are separated by scarcely their width. Coxae subequal in length, the last one with a short pale stridulating spur on the retrolateral side which presumably contacts the striae on the epigastric plates of the abdomen. Chelicera subvertical, rather large, the claw long, curved at the end, the frontal surface with four cusps or weak teeth in a row near the outer side, the lower margin with four subequal, sharp teeth and three small denticles, the upper margin with two or three sharp teeth. Outer margin of the chelicera with a patch of fine stridulating ridges near the distal end. Palpus as illustrated in Figs. 25 and 26, the patella with a short spur on the ventral surface.

TYPE LOCALITY.—Male holotype from five miles north of Tamaunchale, San Luis Potosi, July 2, 1936 (A. M. and L. I. Davis).

This species is related to *Erigone brevidentata* Emerton and allies but differs radically in characters of the palpus.

Eperigone tlaxcalana, new species

Figures 39 and 40

FEMALE.—Total length, 2.40 mm.

	CARAPACE	FRONT	STERNUM	LABIUM	MAXILLA	ABDOMEN
Length	1.20	0.36	0.67	0.15	0.33	1.35 mm.
Width	0.86	0.53	0.62	0.20	0.20	0.95 mm.

Carapace light yellowish brown, slightly infuscated on the sides, with faint radiating black streaks, the eyes ringed with black and enclosing a black field. Sternum nearly black, clothed with a few long erect black hairs. Labium and maxillae infuscated on the sides. Legs slightly paler than the carapace, unmarked, clothed evenly with rows of black hairs. Abdomen gray to black, the dorsum with a median row of five pairs of white spots.

Carapace suboval, weakly rounded in front, the head portion narrowed, the cephalic sutures nearly obsolete, the median groove inconspicuous, a slight longitudinal groove. Clypeus sloping slightly forward, equal in height to three and one-half times the diameter of an anterior median eye. Ratio of the eyes: ALE:AME:PLE:PME = 8:6:8:8. First row of eyes straight as seen from in front, the medians separated by one-fifth their diameter, twice as far from the laterals. Second row of eyes gently procurved, the medians separated by three-fourths their diameter, slightly nearer the laterals (5/6). Median ocular quadrangle broader than long (21/18), narrowed in front (21/13). Sternum truncated in front, gently rounded

on the sides, truncated between the posterior coxae which are separated by scarcely their width (17/21). Endites subparallel. Chelicerae average in size, the lower margin with four teeth, the two near the base of the claw joined at their bases, the upper margin with five teeth. Outer side of the chelicera with a small patch of coarse striae. Epigynum as illustrated in Figs. 39 and 40, a broad plate with the terminal portion curved downward.

TYPE LOCALITY.—Female holotype from Tlaxcala, Tlaxcala, June 25, 1936 (L. I. Davis).

Eperigone agressa, new species

Figures 32, 33, and 41

MALE.—Total length, 2.80 mm.

	CARAPACE	FRONT	STERNUM	LABIUM	MAXILLA	ABDOMEN
Length	1.30	0.42	0.67	0.12	0.36	1.55 mm.
Width	0.98	0.60	0.72	0.20	0.26	1.08 mm.

Carapace light brown, lightly infuscated, the pars thoracica with inconspicuous dark radiating lines, the eyes ringed with black. Sternum and labium black or nearly so, clothed sparsely with erect black hairs. Coxae dusky below, the legs otherwise yellowish brown, clothed evenly with rows of black hairs. Abdomen gray to black, with a large pale area at the base of the dorsum which is followed by three or four pairs of white spots, the whole pattern indistinct. Venter of the abdomen nearly black.

Carapace suboval, somewhat narrowed and gently rounded in front, highest at the second eye row, convex, the median suture an inconspicuous longitudinal groove, the cephalic sutures nearly obsolete. Pars cephalica moderately elevated, the clypeus subvertical, equal in height to four times the diameter of an anterior median eye. Ratio of the eyes: ALE:AME:PLE:PME = 9:6.5:9:9. First row of eyes straight as seen from in front, the medians separated by scarcely half their radius, nearly twice as far from the laterals. Second row of eyes weakly procurved, the medians separated by their radius (9/5), as far from the laterals. Median ocular quadrangle as broad as long, narrowed in front (22/15). Sternum truncated in front, the front coxae separated by nearly twice their length, truncated behind, the posterior coxae separated by scarcely three-fourths their width. Chelicera moderately heavy, the outer side with two cusps followed by three or four very weak ones, the frontal surface with a stout tooth near the distal end above the upper claw row. Lower margin of the furrow with four, the upper with five teeth. Outer surface of the chelicera with a patch of coarse striae. Palpus as illustrated in Figs. 32 and 33.

FEMALE.—Total length, 3.00 mm.

Coloration and structure in close agreement with the male. Posterior eye row essentially straight, the eyes and relations otherwise as in the other sex. Epigynum as illustrated in Fig. 41, suggestive of *Eperigone dopainum* Chamberlin and Ivie but distinct in details.

TYPE LOCALITY.—Male holotype, female allotype and paratype from Las Cruces, Mexico, June 28, 1936 (L. I. Davis).

Eperigone annamae, new species

Figures 34 and 35

MALE.—Total length, 1.75 mm.

	CARAPACE	FRONT	STERNUM	LABIUM	MAXILLA	ABDOMEN.
Length	0.85	0.25	0.47	0.07	0.17	0.95 mm.
Width	0.62	0.40	0.45	0.15	0.15	0.62 mm.

Carapace yellow to orange, unmarked, the eyes ringed in black and enclosing a dark field. Sternum and labium dusky, the maxillae dull yellow, the clothing of the under side erect black hairs. Legs concolorous with the carapace, clothed evenly with rows of black hairs. Abdomen gray to black, the dorsum with a large pale basal area and transverse pale bands in the caudal half, the venter dusky.

Carapace suboval considerably narrowed and gently rounded in front, the cephalic sutures virtually obsolete, the median suture an inconspicuous longitudinal groove. Clypeus vertical, equal in height to three diameters of an anterior median eye. Ratio of the eyes: ALE:AME:PLE:PME = 6:4:6:6. First row of eyes straight, the medians separated by half their radius, a little farther from the laterals. Second row of eyes weakly procurved, the medians separated by about the radius, as far from the laterals. Median ocular quadrangle as broad as long, narrowed in front (15/8). Sternum broadly truncated in front, the first coxae separated by twice their length, rounded on the sides, narrowly truncated between the posterior coxae which are separated by scarcely their width. Chelicera normal in size, lacking lateral or frontal teeth, the lower margin with four, the upper with five teeth. Palpus as illustrated in Figs. 34 and 35, the tibia with a slight rounded carina behind the principal tibial apophysis.

TYPE LOCALITY.—Male holotype from Las Cruces, Mexico, June 28, 1936 (A. M. and L. I. Davis).

Eperigone tepejicana, new species

Figures 36, 37, and 38

MALE.—Total length, 2.15 mm.

	CARAPACE	FRONT	STERNUM	LABIUM	MAXILLA	ABDOMEN
Length	1.10	0.44	0.60	0.17	0.30	1.10 mm.
Width	0.86	0.60	0.60	0.09	0.23	0.70 mm.

Carapace dull yellowish brown, lightly and uniformly infuscated, the eyes ringed with black. Sternum and labium dusky, the endites pale yellowish brown, the clothing erect black hairs. Legs concolorous with the carapace, slightly dusky, clothed evenly with rows of black hairs. Abdomen nearly black, the dorsum with an indistinct median longitudinal pale stripe made up of pairs of spots, the venter dark.

Carapace suboval, rather broad and rounded in front, highest at the second eye row, the median longitudinal groove present but the cephalic sutures nearly obsolete. Clypeus subvertical, equal in height to scarcely three times the diameter of an anterior median eye. Ratio of the eyes: ALE:AME:PLE:PME = 9:6:9:9.

First row of eyes straight, the medians separated by about half their radius, a little farther from the larger laterals. Second row of eyes essentially straight, the medians separated by two-thirds their diameter, about as far from the laterals. Median ocular quadrangle slightly broader than long (18/16), narrowed in front (18/12). Sternum broadly truncated in front, separating the first coxae by twice their length, narrowly truncated behind, the posterior coxae separated by about their width. Chelicera normal in size, the anterior face with a stout tooth, the outer side with two weak cusps, the lower margin with four, the upper with five teeth. Palpus as illustrated in Figs. 36, 37, and 38, differing from the other species in the details of the tibial apophysis and the apophyses on the bulb.

TYPE LOCALITY.—Male holotype from Tepeji, Hidalgo, June 15, 1936 (A. M. and L. I. Davis).

Ceratinopsis guerrerensis, new species

Figures 42 and 43

MALE.—Total length, 1.30 mm.

	CARAPACE	FRONT	STERNUM	LABIUM	ENDITE	ABDOMEN
Length	0.60	0.24	0.37	0.06	0.14	0.80 mm.
Width	0.46	0.30	0.36	0.12	0.13	0.50 mm.

Carapace nearly black, a few pale spots showing through the dark coloration. Sternum and labium black, the endites somewhat paler distally, the clothing erect black hairs. Coxae dusky beneath, the legs otherwise pale yellow, set with rows of black hairs. Abdomen light brown, dusky, darker caudally.

Carapace suboval, moderately narrowed in front, the cephalic sutures nearly obsolete, the median groove longitudinal. Clypeus slightly excavated below the eye group, subvertical, equal in height to three diameters of an anterior median eye. Ratio of the eyes: ALE:AME:PLE:PME = 5:4:5:5. Eyes of the first row very weakly procurved, the medians separated by their radius, a little farther from the laterals. Second row of eyes straight, the medians separated by three-fifths their diameter, as far from the laterals. Median ocular quadrangle broader than long (14/11), narrowed in front (14/10). Sternum about as long as broad, broadly truncated in front, the first coxae separated by twice their length, the sides rounded, narrowly truncated between the posterior coxae which are separated by their length. Chelicerae dusky, average in size, the upper margin of the furrow with five, the lower with two teeth. Palpus as illustrated in Figs. 42 and 43, agreeing closely with *Ceratinopsis purpureascens* (Keyserling) but differing in the details of the tibial apophysis and the tail-piece of the bulb. *Ceratinopsis guerrerensis* is a smaller, darker species.

TYPE LOCALITY.—Male holotype from two miles north of Acapulco, Guerrero, June 18, 1936 (A. M. and L. I. Davis).

Ceratinopsis anglicana (Hentz)

Theridion anglicanum HENTZ, 1850, Journ. Boston Soc. Nat. Hist., VI, p. 275, Pl. IX, fig. 6.

RECORD.—Tamaulipas: Arroyo La Chorrera, March 28, 1937, female (A. M. and L. I. Davis).

Grammonota gentilis Banks

Grammonota gentilis BANKS, 1898, Proc. California Acad. Sci., (3) I, p. 241, Pl. XIV, fig. 24.

Grammonota spinimana EMERTON, 1923, Canadian Entomologist, LV, p. 240, Fig. 3.

RECORDS.—Coahuila: Saltillo, July 3, 1936, females (L. I. Davis). Mexico: Crater of Mount Toluca, June 28, 1936, males and females (A. M. and L. I. Davis).

Specimens of the species identified as *Grammonota gentilis* Banks from Mexico differ in no important respect from those from various localities in the western United States. The examples from Mount Toluca are much darker than those from lower altitudes.

Grammonota texana (Banks)

Acartauchenius texanus BANKS, 1899, Proc. Ent. Soc. Washington, IV, p. 192.

RECORD.—Guerrero: Acapulco, June 17, 1936, female (Davis).

Grammonota sclerata Ivie and Barrows

Grammonota sclerata IVIE AND BARROWS, 1935, Bull. Univ. Utah, (26), Biol. Ser., III, p. 14, Pl. VI, figs. 48-51.

RECORDS.—Nuevo Leon: fifty-four miles south of Laredo, Texas, July 1, 1936, males and females (Davis). Coahuila: Twenty miles east of San Pedro, July 5, 1936, three females, (A. M. and L. I. Davis).

Grammonota nigrifrons Gertsch and Mulaik

Grammonota nigrifrons GERTSCH AND MULAİK, 1936, American Mus. Novitates, No. 863, p. 2, Figs. 8 and 9.

RECORD.—Tamaulipas: San Fernando, March 28, 1937, male (Davis).

Grammonota suspiciosa Gertsch and Mulaik

Grammonota suspiciosa GERTSCH AND MULAİK, 1936, American Mus. Novitates, No. 863, p. 2, Figs. 6 and 7.

RECORD.—Nuevo Leon: twenty-eight miles north of Monterrey, July 7, 1936, two females (Davis).

Ceraticelus similis (Banks)

Erigone similis BANKS, 1892, Proc. Acad. Nat. Sci. Philadelphia, p. 31, Pl. v, fig. 61.

RECORD.—Tamaulipas: San Fernando, March 28, 1937, males and females (Davis).

AMERICAN MUSEUM NOVITATES

Number 962

Published by
THE AMERICAN MUSEUM OF NATURAL HISTORY
New York City

Nov. 18, 1937

STUDIES OF PERUVIAN BIRDS. NO. XXVII¹

NOTES ON THE GENERA *MUSCIVORA*, *TYRANNUS*, *EMPIDONOMUS*, AND *SIRYSTES*, WITH FURTHER NOTES ON *KNIPOLEGUS*

BY JOHN T. ZIMMER

I am greatly indebted to Messrs. C. C. Gregg and Rudyerd Boulton of Field Museum of Natural History, Chicago, for the loan of certain critical specimens used in the following study.

Names of colors are capitalized when direct comparison has been made with Ridgway's 'Color Standards and Color Nomenclature.'

Muscivora tyrannus tyrannus (Linnaeus)

(*Muscicapa*) *Tyrannus* LINNAEUS, 1766, 'Syst. Nat.,' ed. 12, I, p. 325—based on *Tyrannus cauda bifurca* BRISSON, 'Orn.,' II, p. 395, Pl. xxxix, fig. 3—"Canada" (error) and Cayenne; Linnaeus gives Canada and Surinam; type locality hereby restricted to Surinam.

Tyrannus savana VIEILLOT, 1807, 'Hist. Ois. Amér. Sept.,' I, p. 72, Pl. XLIII—new name for *Muscicapa tyrannus* LINNAEUS.

Muscicapa phaenoleuca VIEILLOT, 1818, 'Nouv. Dict. Hist. Nat.,' nouv. éd., XXI, p. 448—based on AZARA, No. 192; Paraguay (= juv.).

Tyrannus violentus VIEILLOT, 1818, *l. c.*, p. 89, based on AZARA, No. 190—Buenos Aires, Montevideo, and Paraguay.

Tyrannus milvulus NUTTALL, 1840, 'Man. Orn. U. S. and Canada,' ed. 2, p. 307—new name for *Muscicapa tyrannus* LINNAEUS.

It has long been the accepted belief that there is but a single form of this species inhabiting the extensive range from Mexico to Patagonia, recently extended to the Falkland Islands. The material examined in the present study tends to disprove this belief and to show that there are some four well-marked forms inhabiting quite distinct areas although one of these forms, being migratory at a certain season, invades parts of the ranges of the other three forms. For one of these forms there is an available name; two forms have proved to be unnamed and are described below.

Linnaeus based his name, *tyrannus*, on birds described by Brisson, supposedly from Canada and Cayenne. The locality, "Canada," is

¹ Previous papers in this series comprise American Museum Novitates, Nos. 500, 509, 523, 524, 538, 545, 558, 584, 646, 647, 668, 703, 728, 753, 756, 757, 785, 819, 860, 861, 862, 889, 893, 894, 917, and 930.

obviously an error (possibly for Grenada?) and I can find no definite records from Cayenne which justify Brisson's other citation, although there is probability that the bird occurs there at certain seasons. On the other hand, Linnaeus also cites "Canada" but, instead of "Cayenne," gives the range as Surinam. Since there are various records from Surinam, I have chosen it for restricted type locality, even though it is only the winter home of one form of the species, far removed from the breeding range. For the reason, also, that there is a slight possibility that one of the other forms may reach this country, although I have no evidence of its doing so, I find it advisable to characterize the form to which I apply the name given by Linnaeus, basing the description on specimens collected in Surinam.

Whole top of head steely blue-black, with a concealed crest of Lemon Chrome, deepening to Light Cadmium in the center and paling to white on forehead, sides of crown, and occiput; back Light Neutral Gray, with a slight olivaceous tinge; lower rump sooty, with grayish edges, rather broad on the upper feathers of this area; upper tail-coverts glossy black. Under parts white except for a small grayish area on the extreme sides of the breast, a gray or drab-gray stripe along the dorsal margin of the femoral area, and a dark patch on the under wing-coverts near the base of the primaries (the patch on the sides of the breast is moderately diagnostic). Remiges brownish fuscous; outer primary with narrow but sharp outer margin yellowish white; remaining remiges narrowly margined exteriorly with grayish white, strongest and whitest on the longest tertial; greater and median upper wing-coverts brownish fuscous with narrow grayish margins; lesser series rather broadly tipped with the gray of the back; inner margins of remiges indistinctly whitish. Tail long and forficulate; blackish, with outer web of outer rectrices pale yellowish for about half the length of the feather. Adult males with three outer remiges very narrowly emarginate at tips of inner webs (the outermost averaging about 1.75 mm. wide; the second, 2; the third, 2.5), with the narrowed portion separated from the wider part by an abrupt, basad-directed notch about 3 mm. deep; length of narrowed portion about 10-12 mm.; fourth rectrix distinctly but less abruptly narrowed, without a notch. Females without strongly emarginate remiges but with emarginations sometimes suggested, without notches; outer rectrices less elongate but tail still strongly forficulate and similarly marked to that of the male. Young birds with head brown instead of black, somewhat darker on the sides and without concealed patch or with a simple whitish one; back brownish gray; rump

brown, with lighter brown tips; upper tail-coverts darker brown, with warmer brown tips. Remiges brown, with external margins buffy whitish; upper wing-coverts brownish, with cinnamonaceous or whitish edges. Under parts of body much as in the adults. Tail brownish, forked, with outer rectrices similarly marked to the adult; remainder with rufescent brown tips and margins.

The distinguishing characteristics of this form are found in the dark coloration of the mantle, the relatively prominent grayish patch at the sides of the breast, and the presence, in the male sex, of three sharply notched primaries with extremely narrow tips and a somewhat emarginate fourth primary.

Two hundred and seventeen specimens at hand may be referred to this form. They come from various localities ranging from Argentina to Dutch Guiana, Trinidad and Tobago, the Mérida region, the upper Orinoco, Cassiquiare, Santa Marta and Bogotá regions, and northern Perú and various localities between. Birds with enlarged gonads are from Argentina, Paraguay, and Rio Grande do Sul, and the only specimens from these areas were collected from October to February. On the other hand, north of this area, from the Matto Grosso Plateau to northern South America, the dates are all from February to November, most of them from March or April to October, and none of the specimens are noted as having enlarged gonads. A résumé of the evidence secured from this material indicates that the birds breed in the neighborhood of Argentina and Paraguay in the summer, from November to January, in a rather worn condition of plumage. Young birds are well grown in December and January, and the population migrates to the northward, probably beginning in January and continuing through February. This migration carries some individuals as far north as the Caribbean coast, and outlying islands and (presumably this form) sometimes as far as Cuba, Bermuda, and the eastern United States.

A complete molt may start as early as February and is continued in both adults and young to as late as July. Some birds are in completely fresh plumage in July; all examples from August on are comparatively fresh, with molt completed. The southward movement appears to be in full swing from the northernmost localities in September and October; my latest specimens are two birds from near Mérida dated October 13, but Chubb records a specimen from British Guiana dated in November. I have a specimen from Pará, taken in November, and another from Orosa, Perú, also collected in November.

The exact status of the bird on the east-Brazilian coast is not cer-

tain. There is no hesitation in the assignment of the specimens from this region to typical *tyrannus*, with which they agree in all observed details, including the chronology of plumages. Several specimens from Rio Grande do Sul are noted as with enlarged gonads, and the bird is probably a breeding form in that state. Pinto reports the arrival of the species in São Paulo in October and in Goyaz in August, but gives no indication of possible breeding records. Our specimens from Minas Geraës were taken in September. Bahian birds are dated February, April, and September, with an April bird having the gonads slightly enlarged. Pinto, however, does not list the species in his account of the birds of Bahia, and I doubt if it is a breeding resident in that state. Nowhere in the tropics does it appear to have been found nesting, and the northern limit of the breeding range probably is south of the Tropic of Capricorn.

Beebe (1925, *Zoologica*, VI, p. 156) records the species as found breeding at Kartabo, British Guiana, in March, but I feel sure that there is some error in this statement. All other available evidence indicates that the bird visits the coast of British Guiana only as a migrant or winter visitor. One of the other subspecies (cf. account of *M. t. monachus*) may reach the highlands of the interior and may be found to breed there but this suggestion has yet to be confirmed.

The amount of yellowish and greenish suffusion in certain parts of the plumage is highly variable. Some birds are very decidedly greenish on the back, and most of the fresh specimens show some yellow tinge on the under wing-coverts. The most pronounced example is a male from Pará which has the whole under surface below the throat definitely pale, greenish yellow instead of white.

The only Peruvian specimens at hand are from Orosa (November) and Sarayacu (March). The Orosa bird is an adult male in moderately fresh plumage; the Sarayacu birds are molting females, one adult, in ragged condition, the other immature.

Other records are from Pebas and Iquitos.

The various synonyms listed at the head of this section appear to be referable to typical *tyrannus*. There is, in addition, one name, based on a Guatemalan bird, which is available for one of the other separable forms, next to be discussed.

***Muscivora tyrannus monachus* (Hartlaub)**

Tyrannus (Milvulus) monachus HARTLAUB, 1844, *Rev. Zool.*, VII, p. 214—Guatemala (= juv.).

The Swallow-tailed Flycatchers of the whole of Central America are quite readily separated from typical *tyrannus* by their much paler gray back, with an even paler and more whitish collar suggested in most cases. The sides of the breast are often as white as the center and never so strongly grayish as they sometimes are in *tyrannus*. Furthermore, the adult males have the tips of the outer primaries emarginate in a very different manner. The outermost is deeply notched and abruptly narrowed to a width of 1.5 or 2 mm.; the second also deeply notched and narrowed to a width of 2.5 mm.; the third is narrowed to no less than 4 or 5 mm., often without a notch, sometimes with a slight notch much less developed than in the other two feathers. The length of the narrowed portion of these feathers is about 10 to 12 mm., about as in *tyrannus*. The fourth remex usually is not at all emarginate. Adult females may have a slight emargination near the tips of one or two outer primaries.

Except for the Santa Marta region, the resident form of Colombia is *monachus*. One "Bogotá" skin belongs to *tyrannus*, as noted on an earlier page. There is a breeding record from the Antioquia region by Salmon (I do not have the date) and Goodfellow has reported that at Popayan, in June, these flycatchers were assembling in large flocks, so it may be presumed that, at least in parts of Colombia, the form breeds in the early part of the year. The condition of the plumage of some of the specimens at hand bears out this assumption, although there is a little indication that the season may vary in different localities. More material will be necessary to determine the point. There is a record from Costa Rica of nesting in May, and April skins from that country are sometimes marked as having enlarged gonads.

Leaving Central America and Colombia where *monachus* is known to breed, we find specimens referable to this form from Lagunillas, near Mérida, Venezuela; from Altigracia, Suapure, Ayacucho, and Maripa, on the Orinoco; from San Antonio, Bermúdez, northern Venezuela; from Limão, Rio Cotinga; Frechal, Rio Surumú; Caracarahy, Rio Branco; and Campos Salles, Manaus, Brazil. Birds in immature plumage from these localities were taken in June and July; young birds collected in August are molting into adult dress. September adults are just completing their molt and are very fresh; December birds are more worn; February and April, very worn; June and July show the first signs of molt. Costa Rican birds of late May and June show the first signs of molt in that region, corresponding fairly well with the South American examples of *monachus*.

Nevertheless, with only the seasonal condition of the plumages on which to base conclusions, I am unable to determine whether *monachus* breeds in Venezuela and northern Brazil or whether it is simply a visitor to this region. I suspect that it may breed in suitable open country in various parts of this area although it may extend its visitations some what beyond the limits of its breeding range, not, however, from points as far distant as Colombia where it remains at the same season as it is found in Venezuela and Brazil. It is interesting, in this connection, to note that of a number of specimens from the Mérida region, collected by Briceño, all but one example of *tyrannus* are labeled as migrants while the skins of *monachus* have no such notation. I have specimens, from Venezuela and northern Brazil taken in every month but March, May, and October, although none of them has any notation as to the condition of the gonads.

It is curious that the collection at hand has few specimens showing the occurrence of both *tyrannus* and *monachus* in the same localities. In the Orinoco region, *tyrannus* is represented from Maipures and Ciudad Bolívar; *monachus* from Maripa, Altagracia, Suapure, and Ayacucho. On the northern coast of Venezuela, *tyrannus* is at hand from Cristóbal Colón and Cumaná; *monachus* from San Antonio. In the Mérida region, *tyrannus* is from El Valle, Hechisera, and Mérida; *monachus* from Lagunillas. Both forms are in "Bogotá" Collections and I have both from Caracarahy, Rio Branco, and Campos Salles, Manaos, Brazil.

There have been some suggestions made that the Central American bird is migratory, at least in part, but there is no evidence, of a positive nature, that I have seen. It breeds in Costa Rica in May (Cherrie) and I have specimens from that country taken in April, May, June, September, and December; Nicaragua, January and May; Mexico in January and February; Panamá in February, March, April, September, October, and December. As stated above, Goodfellow (1901, Ibis, p. 708) remarks that at Popayan, Colombia, in June, the species was assembling in large flocks, but no migratory movement is mentioned. It would not be surprising if there were some concentration of individuals in favored localities but it is doubtful if this tropical form has any protracted migration to a distant but equally tropical region. although there is some evidence of such migration in at least one species of the family to be discussed in a later paper of this series.

Further field work is necessary to ascertain the exact status of *monachus* in many parts of its range.

With the exception of a single wintering specimen of *tyrannus* from Cienaga, the available series of birds from the Santa Marta region is quite separable from both *tyrannus* and *monachus*. Since there is no available name for this form, it may be known as follows.

Muscivora tyrannus sanctaemartae, new subspecies

Figure 1

TYPE from Bonda, Santa Marta, Colombia. No. 97,670, American Museum of Natural History. Adult male collected February 4, 1899, by G. H. Hull.

DIAGNOSIS.—Similar to *M. t. monachus* of Central America and most of central and western Colombia in respect to pale coloration of the back, but emargination of the outer primaries quite different. Males with the emarginate tip of the two outer primaries relatively broad and long and without a sharp notch separating it from the remainder of the inner outline of the feather; third primary with terminal emargination shorter, broader, and still less sharply defined. Females with suggestions of notches on the three outer primaries (suggesting the condition in the males of *monachus*), but the emarginate tips short and those on the outer two feathers twice as broad as in the males of *monachus*.

RANGE.—Apparently confined to the Santa Marta region of northern Colombia.

DESCRIPTION OF TYPE.—Whole top and sides of head steely bluish black, including auriculars and nape; center of the cap occupied by a broad, concealed patch of yellow (Lemon Yellow in the deepest hue portion) passing on all sides into pure white, similarly concealed; hind neck somewhat whitish, suggesting a poorly defined collar; upper portion of mantle Pale Gull Gray, passing posteriorly into a slightly darker tone, faintly tinged with Pale Olive Gray; rump and upper tail-coverts rather abruptly blackish, with pale margins, broader and grayer on upper rump and becoming narrower and more brownish on upper tail-coverts, being nearly obsolete on the longest coverts. Entire under parts white except for a dusky patch on the under wing-coverts near the bases of the primaries, and for a grayish dorsal border of the femoral area. Remiges blackish, with a fine yellowish-white margin on outer web of outer primary; distal portion of outer margins of remaining primaries also whitish, decreasing in amount toward inner primaries but tending to round tips; secondaries and tertials with whitish outer margins and tips, longest on longest tertial; upper wing-coverts fuscous, margined with pale gray; lesser coverts with these margins broadest, grading into the uniform gray of the scapulars; inner margins of remiges whitish, poorly defined. Outer two primaries emarginate for about 18 to 20 mm. from tips, narrowed on inner web to an average width of 4 mm. but without a distinct notch at the point of transition; third outer primary slightly emarginate, reduced to about 5 mm., also without a notch. Tail forcate, black, with outer web of outermost rectrix white at base, the pale margins becoming reduced in width distad and disappearing about midway toward the tip. Bill (in dried skin) black; feet dark brown. Wing, 104 mm.; tail, 283; exposed culmen, 14; culmen from base, 19; tarsus, 15.5.

REMARKS.—Female colored like the male; somewhat smaller, especially in length of tail. Wing, at least sometimes, with outermost rectrices narrowed at tip to about the same width as in the male but for

a length of only 10 mm. and with a definite notch on at least the two outer feathers.

Specimens at hand were taken in January, February, May, and September, and Todd records others collected in August. September birds, both adults and young, are molting; January and February birds are fairly fresh. I have no information as to breeding, but analogy with the other forms of the species with reference to the condition of the plumage in the specimens examined places the probable nesting season as April, May, or June.

A single specimen from Cienaga, whence there are five other specimens that are referable to *sanctaemartae*, is a migrant *tyrannus*, readily distinguishable by color as well as by the shape of such of the outer primaries as have appeared in the molt.

One male from Bonda has the narrowed terminal portion of the outer two primaries separated from the wider portion by a rather short but distinct notch, but it is the only male so marked. This character is developed as a constant feature in the birds from a widely separated region, the neighborhood of the Rio Tapajoz, south of the Amazon, in Brazil. Although numerous specimens from the neighborhood of the Rio Tapajoz are clearly wintering individuals of *tyrannus*, there are many specimens in a different state of plumage which are quite readily separable as a distinct form which may be known as follows.

Muscivora tyrannus circumdatus, new subspecies

Figure 1

TYPE from Tauary, right bank of Rio Tapajoz, Brazil. No. 287,357, American Museum of Natural History. Adult female collected April 18, 1931, by A. M. Olalla.

DIAGNOSIS.—Nearest to *M. t. sanctaemartae*, of the Santa Marta region of Colombia, and averaging as pale gray on the back, but with the concealed patch on the crown averaging deeper yellow; emargination of the outer two primaries of the male different, having a deep notch on the inner margin, about 17 mm. from the tip, abruptly separating the narrowed terminal portion from the broader area posteriad. Females with or without modified terminal emargination.

RANGE.—South bank of the Rio Amazonas, Brazil, from the neighborhood of Villa Bella Imperatriz at least to the right bank of the Tapajoz.

DESCRIPTION OF TYPE.—Top and sides of head steely bluish black; center of cap occupied by a broad concealed patch of Deep Chrome \times Light Cadmium, deepest in the median line and replaced on all borders by white; mantle Gull Gray \times Light Gull Gray, paler and somewhat whitish anteriorly, suggesting an indistinct collar; posteriorly darker and somewhat tinged with greenish; rump and upper tail-coverts blackish, with pale margins which are broad and grayish on the upper rump, narrower on the lower part, and nearly obsolete on the upper tail-coverts. Entire

under parts white except for a slight grayish upper border on the femoral tract and a dark patch on the under wing-coverts near the base of the primaries. Remiges blackish with a fine, yellowish-white margin on the outer web of the outermost primary; pale margins on remaining primaries and on the secondaries grayer and less sharply defined, but those on the longer tertials whiter and rather well defined; upper wing-coverts fuscous with gray margins; inner margins of remiges yellowish white, at least basally. Outer two primaries abruptly narrowed on the inner webs to a width of 3 mm. by a diagonal notch directed basad, about 3 mm. deep, with the narrowed portion of the feather about 17 mm. in length; third primary less abruptly narrowed to a width of 6 mm., about 18 mm. from the tip of the feather, without a notch. Tail long and forficat, black, with the outer web of the outer feather yellowish white for about half its basal length. Bill (in dried skin) black; feet black. Wing, 110 mm.; tail, 262; exposed culmen, 14.5; culmen from base, 19.5; tarsus, 17.

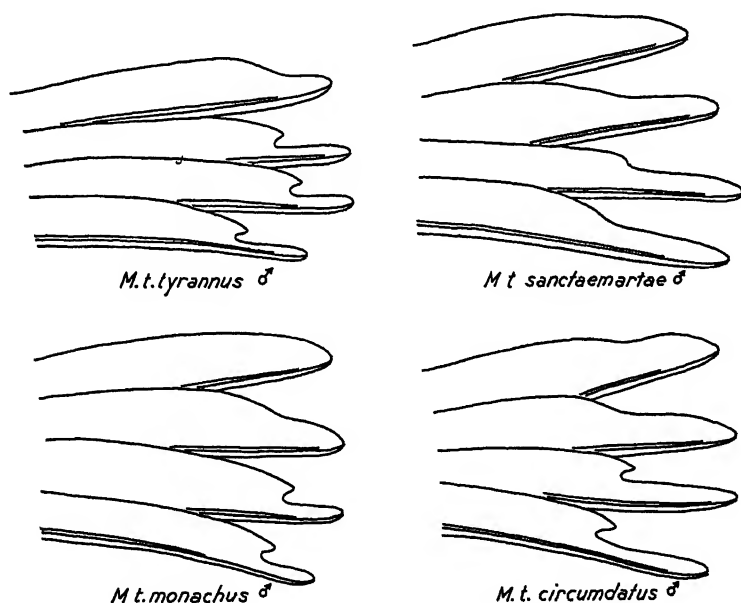


Fig. 1. *Muscivora tyrannus*. Ventral aspects of the outer primaries of the various subspecies.

REMARKS.—Female colored like the male but with tail shorter (less than 200 mm.); outer two primaries sometimes abruptly narrowed to an average width of 4 mm. for a distance of 6 or 7 mm. from the tip, with a slight notch; third very slightly emarginate at tip; sometimes all outer primaries without more than a suggestion of emargination.

I have thirty-eight specimens which show the characters of this form.

The females are not separable from those of *sanctaemartae*, except that the outer margins of the basal half of the outer web of the outermost rectrices often are definitely tinged with yellowish, whereas in *sanctaemartae* they average purer white. The adult males all have the decided notch at the base of the emargination of the outer two primaries which is the principal character of *circumdatus* and which, as noted on an earlier page, is rarely developed in *sanctaemartae*.

The specimens of *circumdatus* show a seasonal condition of plumage different from that of the Santa Marta birds. Specimens collected in February and March are just beginning their molt; June birds are all but completely molted; August skins already show some wear. One April 29 bird is just completing its post-juvenal molt and is in its first adult plumage. As noted above, *sanctaemartae* is in early molt in September, fresh in January, and has the post-juvenal molt in progress also in September. There is no possibility, therefore, that the Tapajoz birds are migrants from the Santa Marta region. The seasonal changes of plumage in *circumdatus* are about as in typical *tyrannus* and the breeding season of this form, therefore, should be about from November to January, when *tyrannus* is absent from the Amazonian region. Breeding records, however, have yet to be established.

There is one specimen, labeled "Espírito Santo, J. B. Steere," which has yet to be authenticated as to locality. It definitely belongs to *circumdatus* and agrees with August skins in regard to the condition of plumage.

SPECIMENS EXAMINED

M. t. tyrannus.—ARGENTINA: La Soledad, 1 ♂, 1 ♀; Salto, 1 ♂; Esperanza, 1 ♂; Est. San Martino, Pr. Buenos Aires, 2 ♂, 1 ♀; Bahía Blanca, 1 ♀; Barracas al Sud, 1 ♂, 1 ♀; Buenos Aires, 1 ♀; Rivadavia, 2 ♂; "Choinbuco," 1 ♂; Perico, Jujuy, 1 ♀; Rosario de Lerma, 7 ♂; Tucumán, 1 ♂; Embarcación, 1 ♂, 1 ♀; La Plata, 1 ♂. URUGUAY: Paysandu, 1 ♂. PARAGUAY: Colonia Risso, 1 ♂; Fort Wheeler, 1 ♂; east of Villa Rica, 2 ♂, 1 ♀; Zanja Moroti, 1 ♂, 1 ♀; east of Caaguassú, 3 ♂; opposite Concepción, 1 ♂; "Paraguay," 3 ♂. BOLIVIA: Todos Santos, 1 ♂, 1 (?); Prov. del Sara, 1 ♂, 1 ♀; Falls of Río Madeira, 1 ♂. BRAZIL: Rio Grande do Sul, (various localities), 12 ♂, 8 ♀, 2 (?); Paraná, Tibagy, 1 ♂, 2(?); Minas Geraes, Agua Suja, 1 ♂; "Rio de Janeiro," 1 [♂]; Bahia, Remanso, 3 ♂, 3 ♀, 3 (?); São Paulo, Victoria, 4 ♂; Fazenda Cayoá, 1 ♀; Matto Grosso, Chapada, 4 ♂, 4 ♀; Pará, 1 ♂; Rio Tapajoz, Santarem, 2 (?); Urucurituba, 2 ♀; Igarapé Brabo, 2 ♀; Igarapé Amorin, 1 ♂; Tauary, 2 ♀, 1 (?); Caxiricatuba, 1 ♀; Aramanay, 1 ♂, 1 ♀; Villa Bella Imperatriz (Santa Clara), 1 ♀; Rio Madeira, Santo Antonio de Guajará, 1 ♂; Calamá, 1 ♂, 3 ♀; Humaythá, 1 ♂; Rio Amazonas, Tefé, 1 ♂; Rio Jamundá, Faro, 10 ♂, 7 ♀; Rio Negro, Flores, Manaos, 2 ♂; Campos Salles, Manaos, 7 ♂, 13 ♀; Tabocal, 1 ♂; Yucabí, 2 ♂, 4 ♀; Mt. Cury-

curyari, 2 ♂, 1 ♀; Santa Maria, 1 ♂; Camanaos, 1 ♂; Igarapé Cacao Pereira, 1 ♀; São Gabriel, 1 ♂, 3 ♀; Muirapinima, 1 ♂; Hacienda Río Negro, Manaos, 2 ♂; Río Branco, Caracarahy, 1 ♂; "Brazil," 1 ♂. PERÚ: Orosa, 1 ♂; Sarayacu, 2 ♀. VENEZUELA: Río Cassiquiare, Solano, 1 ♂; El Merey, 1 ♂; Mouth of Río Ocamo, 4 ♀, opposite mouth of Ocamo, 1 ♀; Río Huayña, junction of Cassiquiare, 1 ♂, 1 (?); Río Caura, mouth of Río Chanaro, 1 ♀; Maipures, 1 ♀; Ciudad Bolívar, 2 ♂, 3 ♀; Mérida, 6 ♂, 2 ♀; El Valle, 1 (?); Hechisera, 1 (?); Cumaná, 1 ♀; Cristóbal Colón, 1 ♂, 1 ♀. TRINIDAD: Caroni, 1 ♂. TOBAGO: 1 ♂. DUTCH GUIANA: near Paramaribo, 1 ♂, 2 ♀. COLOMBIA: "Bogotá," 1 ♂; Cienaga, Santa Marta, 1 ♂. "SOUTH AMERICA," 1 ♂.

M. t. circumdatus.—BRAZIL: Río Tapajoz, Santarem, 1 ♂; Urucuritiba, 1 ♀; Igarapé Brabo, 5 ♂, 1 ♀; Tauary, 5 ♂ (incl. type), 3 ♀; Río Amazonas, Villa Bella Imperatriz (Santa Clara), 6 ♂, 6 ♀; "Brazil," 1 ♂; "Espírito Santo" [?], 1 ♂; (no locality), 2 ♂.

M. t. sanctaemariae.—COLOMBIA: Santa Marta, Bonda, 4 ♂ (incl. type), 3 ♀; Valparaiso, 1 ♂; Cienaga, 3 ♂, 1 ♀, 1 (?).

M. t. monachus.—MEXICO: Tlacotalpan, 1 ♂, 2 ♀; San Juan Bautista, Tobaasco, 1 ♂. GUATEMALA: Antigua, 1 ♂; Vera Paz, 1 ♂. HONDURAS: Agua Azul, 1 ♀. NICARAGUA: Saklin, 1 ♂, 1 ♀; Jalapa, 1 ♂, 1 ♀. COSTA RICA: Miravalles, 1 ♂; San José, 3 ♂, 3 ♀; Agua Caliente, 9 ♂, 5 ♀; Aquinares, 2 ♂, 1 ♀; Buenos Aires, 3 ♂, 4 ♀; Cartago, 1 ♂, 1 ♀. PANAMÁ: Santiago, 3 ♂, 2 ♀; Agua Dulce, 1 ♀; Chiriquí, 1 ♂, 1 (?); [Lion Hill], 1 ♂, 1 ♀; Savanna near Panamá, 1 ♂; Boquete, 2 ♂, 1 ♀. COLOMBIA: Cali, 4 ♂, 2 ♀; Palmira, 1 ♂; Chicoral, 1 ♀; Barro Blanco, 2 ♂, 1 ♀; Turbaco, 1 "♂"; near Medellín, 1 (?); Santo Domingo, 1 ♀; Popayan, 1 ♂; "Bogotá," 3 [♂], 2 [♀], 1 (?). VENEZUELA: Altagracia, 4 ♂, 1 ♀; Suapure, 1 ♂; Ayacucho, 1 ♂; Maripa, 2 ♂, 1 ♀; Lagunillas, 1 ♂, 1 (?); San Antonio, Bermúdez, 2 ♂. BRAZIL: Río Cotinga, Limão, 1 ♀; Río Surumú, 2 ♂; Río Branco, Caracarahy, 1 ♀; Río Negro, Campos Salles, Manaos, 1 ♂.

Tyrannus tyrannus (Linnaeus)

Lanius tyrannus LINNAEUS, 1758, 'Syst. Nat.,' ed. 10, I, p. 94—based on *Muscicapa corona rubra* CATESBY, 'Nat. Hist. Carolina,' I, p. 55, Pl. LV; Carolina.

Sarayacu, 2 ♂; Santa Rosa, Río Ucayali, 13 ♂, 5 ♀; mouth of Río Urubamba, 3 ♂, 2 ♀.

These specimens, of course, are winter visitants from North America. They are interesting chiefly for the light which they throw on the molt of this species. Fifty-five other specimens from various parts of the winter range in Central and South America have been studied in the same connection, and the result of the study points to certain rather definite conclusions.

As pointed out by Dwight (1900, Ann. N. Y. Acad. Sci., XIII, p. 140) there are the first signs of post-nuptial molt before the species leaves for the south in August, but these are very slight, sometimes only noticeable on the top of the head. Some September specimens from the tropics show little more evidence than this, although other Sep-

tember birds may have the head well advanced and the body molt in progress. In September, also, the young of the year show the first signs of change on the head. If the molt has not advanced very far, the old plumage of the adults may be badly abraded by this time, although the young birds, having worn their plumage for a shorter time, are relatively fresher than the adults. In October, the body molt may be well advanced or, if not, the old plumage, including the flight-feathers (in spite of Dwight's assertion that these are subject to little wear) is in rags; the young birds also show the effects of wear by this time. In November, the body molt is usually well advanced in adults, although sometimes it is not, while the immature birds, if they have not started before, are commencing this change. In rare instances, the wing shows signs of molt on secondaries and tertials. In December, the wing is at least started and there may be signs of molt in the tail, although a young bird from Bolivia is just getting the head, body, and wing started. I have no January or February specimens, but numerous March skins show, variously, the head, body, and wings well advanced and the tail in progress, all areas advanced, or the molt apparently complete. All April and May specimens are in fine, fresh plumage, ready for the ensuing breeding season. Apparently, therefore, almost the entire season of absence from the breeding range is occupied in a protracted molt which may begin just before the fall migration, in the case of the adults, or soon after reaching winter quarters, in the case of the young birds, although it may be somewhat delayed. There is no evidence, in the material examined, of a possible second molt, suggested by Dwight as a possibility. The time occupied by the single annual molt is too extended to leave room for a second change other than the casual replacement of lost feathers.

I am hesitant about the recognition of a subspecies, *hespericola* [Oberholser, 1932, Sci. Publ. Cleveland Mus., IV (1), p. 3—Mouth of Twenty Mile Creek, Warner Valley, Oregon], described as larger than *tyrannus*, with lighter upper surface and longer white tip to the tail. I have seen no topotypes but have two winter birds from Panamá, identified as this form by the author of it. In general, western birds are slightly larger than eastern ones and may be slightly paler in dorsal coloration, but the overlap appears to be too large to warrant separation. The great abrasion of the plumage in winter birds, except just before the northward movement, makes the recognition of any such forms at this season a matter of problematical accuracy. Some of the Peruvian skins at hand are quite large, but they can be matched in certain specimens from the

eastern part of the United States although they come within the range of measurements given for the Oregon form. Until the status of "*hespericola*" is determined by a detailed study of the birds of the entire western part of the United States and the limits of its variations and range ascertained, it would be futile to attempt to identify the wintering specimens from South America.

Other Peruvian records are from Lima, Nauta, and Yurimaguas.

SPECIMENS EXAMINED

M. tyrannus.—PERÚ: 25. BOLIVIA: 8. ECUADOR: 6. COLOMBIA: 12. PANAMÁ: 19. COSTA RICA: 1. NICARAGUA: 4. GUATEMALA: 4. VENEZUELA: 1. UNITED STATES and CANADA: 171.

Tyrannus albogularis Burmeister

Tyrannus albogularis BURMEISTER, 1856, 'Syst. Übers. Th. Bras.,' II, p. 645—Bahia and Pernambuco, Brazil; Halle Mus.

I have sixty specimens of this species before me from numerous localities, some of which extend the range far beyond its previously known limits. The most distant of the localities is Sarayacu, Perú, whence I have five skins, representing the first records from this country. Thus far there have appeared no records to confirm Burmeister's citation of Bahia and Pernambuco but there are records from the states of Minas Geraës and Goyaz which make Bahia not too great an impossibility. Hence I leave Burmeister's citation uncriticized although it is in need of confirmation.

I can find no subspecific differences in the material examined. Young birds differ from adults by lacking the red crown-patch (sometimes suggested by a small whitish area); by having the pale margins of the wings and upper wing-coverts buffy or cinnamon; by having the upper tail-coverts margined with dull rufous and the rectrices (except the outermost) similarly rufous-edged; by having a brownish tinge on the tips of the under tail-coverts; and sometimes by having the lower belly and under tail-coverts largely whitish instead of yellow.

March and April birds are very worn and in an early stage of complete molt; August and September specimens are quite fresh or just completing the molt. None of the specimens has indication of enlarged gonads.

SPECIMENS EXAMINED

T. albogularis.—BRAZIL: MATTO GROSSO, Chapada, 6 ♂, 8 ♀; Rio Tapajoz, Santarem, 1 ♂; Tauary, 1 ♀; Aramanay, 1 ♂, 2 ♀; Rio Amazonas, Villa Bella Imperatriz, 3 ♂, 3 ♀; Rio Madeira, Rosarinho, 2 ♂, 1 ♀; Santo Antonio de Gua-

jará, 6 ♂, 11 ♀; Tefé, 2 ♂, 2 ♀; Rio Negro, Campos Salles, Manaus, 2 ♂, 1 ♀; Hacienda Rio Negro, 1 ♂; Igarapé Cacao Pereira, 1 ♀. PERÚ: Sarayacu, 4 ♂, 1 ♀.

Tyrannus melancholicus melancholicus Vieillot

Tyrannus melancholicus VIEILLOT, 1819, 'Nouv. Dict. Hist. Nat.,' nouv. éd., XXXV, p. 48—based on AZARA, No. 198; Paraguay.

Muscicapa furcata SPIX, 1825, 'Av. Bras.,' II, p. 15, Pl. XIX—"in locis campestribus Brasiliae" (probably somewhere in São Paulo or Rio de Janeiro; Hellmayr); Munich Mus.

Tyrannus roseus LESSON, 1831, 'Traité d'Orn.,' p. 382—no locality = southern Brazil; Paris Mus.

This species is exceedingly unsatisfactory taxonomically. There is a great deal of individual variation in different directions with a concentration of certain averages of different sorts in certain geographical areas without very clear distinctions. It would be possible to describe and name at least five new subspecies, each with a certain combination of characters not possessed by the others although most of them would represent populations intermediate between better marked extremes. One of them appears to represent a new extreme to which I have given a name in the following pages; the others I have discussed in general terms without applying separate nomenclature. A very special study must be made before any further lines of demarcation can be established. With some seven hundred and fifty specimens from South America I find it impossible to segregate more than four subspecies with any degree of certainty and even the lines between these are not too definite.

For example, most of the Amazonian region is occupied by a variable form which averages darker on the back, with more pronounced dark centers to the mantle-feathers, and with more whitish throat than the typical Paraguayan *melancholicus*, but there are very many specimens from this region which are indistinguishable from the southern birds. I have attempted to consider these birds as migrants of *melancholicus*, and it is quite possible that many of them are, truly, migrants from the southern regions; but wherever found, there is intergradation with the darker, whiter-throated birds of the immediate locality and I can find no definite lines of demarcation.

On the other hand, some of the southern birds match the average dark bird from the Amazonian region although they do not reach the extreme development in this direction that is shown by the best-marked examples from the more northern localities.

It is certain that *melancholicus* is at least partially migratory. It is reported as leaving the southern parts of its range about in March

and returning in September. On departure, adults are rather badly worn and faded and young birds are still in juvenal plumage, but, on return, all the individuals are fairly fresh. During the breeding season, abrasion of the plumage gradually increases.

In southeastern Perú, Bolivia, Matto Grosso, and parts of eastern Brazil, there is no certain evidence of northward migration in winter and specimens are at hand collected in these areas at various times through most of the year. The series as a whole shows that a general molt commences in February or March and continues through April, possibly slightly later. June birds are in full, fresh plumage. I have no material suggesting a possible partial molt later in the year, although such evidence is at hand regarding the populations of the Amazonian region.

Here there appear to be two molts each year, although one of them may be only partial and sometimes shows a mere replacement of certain worn feathers. I have been unable to get a very clear picture of the process, due to the fact that the material from different parts of the year has often been collected in different localities where conditions may differ.

Some very curious conditions of plumage are observable. Not infrequently the plumage shows mixed fresh and worn feathers without positive proof of an active molt. A July male from the lower Rio Negro has most of the remiges fairly fresh, but the tertials and body plumage are quite ragged. A January female from the same region has the remiges and body plumage generally badly worn, but the tertials are quite fresh; a January male is similar to the female but has started molt on body and wings. Some specimens show the outer few primaries badly worn and the remainder less worn but not fresh. Similarly, the two median rectrices may be replaced independently of the remaining tail-feathers.

In general, the principal molt occurs from February to July, sometimes as late as August, although it is probable that many of the later molting specimens are completing the post-juvenal molt, having reached a stage when the determination of age is impossible. There is some replacement of plumage in October, November, and December but the greatest part of the specimens at hand with dates as late as this are variously fresh or worn.

The young birds apparently molt a little later than the adults and the presence of young specimens of obviously different ages, though with closely approximate dates of collection, suggests the possibility of two broods or of considerable variation in nesting dates. In any case, there

are at hand two molting immature birds collected in April, two in May, two in July, two in August, two in October, two in November, and one in December.

Some young birds are like the average northern adults in the possession of a strongly whitish throat and markedly dark subterminal areas on the back-feathers, but many other young are as dull and unmarked on the back and with as dull throats as typical *melancholicus*. Some in the process of molt are obtaining the darker characters of adults.

The determination of the birds from the region including the Rio Tapajoz, the Xingú, the Tocantins, and the Pará district is largely a matter of individual preference. When compared with a series of Bahian specimens, the lower Amazonian birds, with few exceptions, are somewhat darker and larger; when the same specimens are compared with typical *melancholicus* they average paler and smaller.

Several specimens from the upper Rio Madeira region also seem to be closer to *despotes* than to *melancholicus* either of the lower Madeira or of the Matto Grosso plateau. They are small and pale birds. On the other hand, a skin from Utiarity, Rio Papagaio, is nearer to *melancholicus*. A larger series from this general region will be necessary to determine the exact nature of the resident form.

North of the Amazon, a somewhat similar condition prevails. Specimens from Faro and from French and Dutch Guiana appear to be slightly closer to *despotes* than to *melancholicus* although certain individuals could be referred to *melancholicus*. A small number of the specimens from the Negro and Cassiquiare regions vary in the other direction and could be referred to *despotes* although most of the individuals are *melancholicus*. There is, in fact, no sharp dividing line but rather a wide area of intergradation in which the evidence of single specimens may prove misleading.

In general, therefore, while there appears to be some evidence on which to suspect the existence of a separable form in the Amazon Valley, with a possible range extending from northeastern Perú and extreme eastern Ecuador to southwestern Venezuela, British Guiana, and the Rio Negro, north of the Amazon, and to the region of Villa Bella Imperatriz on the south bank of that river, it is impossible to present trenchant characters for its separation.

The records from Perú which appear to belong to *melancholicus* are from Lake Titicaca, Huaynapata, Cosñipata, Iquitos, Pebas, and possibly Nauta. Records from Yurimaguas, Chayavitas, and Jeberos are

doubtful and may belong to the Andean form of northern Perú, next to be discussed.

Tyrannus melancholicus obscurus, new subspecies

TYPE from Palambla, Dept. Piura, Perú; altitude 3900-6500 feet. No. 175,451, American Museum of Natural History. Adult male collected September 17, 1922, by Harry Watkins.

DIAGNOSIS.—Similar to *T. m. melancholicus* of Paraguay and adjacent areas, but back darker and much grayer, chest more shaded with grayish, and center of chin and upper throat much whiter; belly often deeper yellow.

RANGE.—Central and western Perú from the Urubamba Valley and the Junín plateau northward through central and western Ecuador to southwestern Colombia (Tumaco).

DESCRIPTION OF TYPE.—Top of head Light Neutral Gray with suggestions of blackish shaft-stripes and with a concealed crest which is Flame Scarlet on the deepest portion, turning to yellow and white on the borders; back with exposed portions of the feathers largely Light Neutral Gray, not sharply defined from the head, with a slight tinge of Yellowish-Olive, stronger on the scapulars; subterminal part of the dorsal feathers brown, sharply defined from the pale gray base; upper tail-coverts brown, with relatively narrow grayish or olive grayish terminal margins, obsolete on the longest coverts. Lores blackish; auriculars dusky on upper portion, pale gray on lower part; malar region and sides of throat Gull Gray; chin and center of throat dull white, slightly tinged with Olive-Buff and slightly grayer toward chest; chest rather narrowly dull Strontian Yellow overlaid with gray on the tips, more broadly on the sides; rest of under parts Strontian Yellow with a shading of Olive Yellow on the lateral parts. Wings dark brown, with indistinct pale outer margins on the primaries, broader and slightly olive-tinted margins on the secondaries, and sharper and whiter borders on the tertials; upper wing-coverts dark brown, with not very conspicuous margins of Smoke Gray; under wing-coverts Citron Yellow with a small brownish patch near the base of the primaries; inner margins of the remiges slightly yellowish; five outer primaries narrowed and emarginate at tips; sixth less noticeably so. Tail dark brown with very narrow pale outer margins and tips, the outer margin broader, sharper, and more yellowish on the outermost rectrix; tail forked for a depth of 16 mm. Bill (in dried skin) blackish; feet brownish black. Wing, 123.25 mm.; tail, 101; exposed culmen, 23; culmen from base, 27; tarsus, 19.

REMARKS.—Females similar but with shorter wings and tail and with less obvious emargination at the tips of the outer primaries.

Specimens from the Junín region are not typical *obscurus* but are closer to this form than to any other. They have the throat pattern of *obscurus* and a somewhat grayish tone on the back (matched by various *obscurus*) but the general tone of coloration is slightly paler on head, back, and under parts, not in the direction of *melancholicus*.

I have not re-examined the specimens from the Huánuco region which I formerly (1930, Field Mus. Nat. Hist. Publ., Zool. Ser., XVII, p. 370) referred to *melancholicus*, but a specimen now at hand from Chu-

churras is like the general Junín series as are three birds from Nuevo Loreto.

Examples from the more arid portions of the west coast of Perú, from Pisco north to the Department of Libertad, are inclined to be a little paler and duller above and below, and to have the bill wider and sometimes longer than in more typical examples of *obscurus* from the more humid areas. Even the specimens from the neighborhood of Cajabamba, at a very high elevation for the species though in a dry region, show this variation while skins from Seques, in a more humid region some distance west of the main chain of the Western Andes, agree with the average of the dark form. It is possible that some subspecific distinction could be made on this basis, but further field studies would be desirable before a formal proposal to effect such separation. Specimens from Palambla, at 4000 to 6000 feet elevation, are among the darkest and grayest of the entire series but they have bills hardly less broad than the specimens from the arid coast. The Arid Tropical Zone at Palambla was found by Watkins, the collector of our Palambla birds, to reach its upper limit at some 2000 feet. If there is a subspecific distinction here as suggested, the large-billed, paler form should be found below Palambla at the lower elevation. In any case, the distinction is not sharply maintained in the series at hand and some of the paler birds have small bills while some darker ones have large bills, as mentioned for Palambla specimens.

Specimens from Ecuador, excepting the examples of *amazonus* from the Napo Valley, also vary somewhat from typical *obscurus*, having a tendency toward the paler *chloronotus* of Central America. The throat is slightly clearer whitish than in Peruvian specimens, the top of the head is a little paler gray, and the back is, on average, a little lighter though it is still quite grayish. Skins from Tumaco, Ricaurte, and the Andes west of Popayan, Colombia, apparently should be referred here also. The rest of the Colombian birds are closer to *chloronotus*, discussed hereunder.

Records which presumably belong to *obscurus* are from Bellavista, Tabaconas, Huayabamba (nesting in February), Tumbes, Santa Lucia, Tambillo, Corral, Chirimoto, Huambo, Paucal, Hacienda Limón, Chachapoyas, Rioja, Moyobamba, Menocucho, Chorrillos, Lima, Pacasmayo, Tarapoto, Chosica, Santa Eulalia, Huánuco, Vista Alegre, Chinchao, Huachipa, Chanchamayo, Monterico, Paltaypampa, San Ramón, La Merced, Huiro, Idma, Río Cosireni, and San Miguel Bridge. Yurimaguas, Jeberos, and Chayavitas are doubtful, possibly belonging to *melancholicus*.

Tyrannus melancholicus chloronotus Berlepsch*Tyrannus chloronotus* BERLEPSCH, 1907, Ornith., XIV, p. 474—Temax, Yucatan.

There seem to be no satisfactory lines of demarcation among the birds from the greater part of Venezuela (excluding the Duida region), Trinidad, Tobago, and Grenada, the Santa Marta region, most of Colombia, and most of Central America. Birds from Panamá average somewhat darker, and Santa Marta specimens paler, than the general average, but without very clear distinctions. The entire series is distinguishable from the birds from almost all other parts of South America by their average smaller size and pale coloration, most resembling the Bahian form, *despotes*, but averaging even paler than that subspecies. The throat is very whitish, with the sides of the area only lightly shaded with pale gray, and the top of the head is clear, light gray; the back is pale green with considerable gray at the tips of many of the feathers, the gray being of a pale tint like the color of the top of the head.

Birds from the north coast of Colombia are quite typical, but those from most other parts of this country average slightly larger and slightly darker on the back although they do not approach either *obscurus* or *melancholicus* close enough to suggest inclusion in either of those forms instead of *chloronotus*. Specimens from the extreme southwestern corner of Colombia are, perhaps, best included in *obscurus* as I have treated them, and some of the specimens from the eastern slope of the eastern Andes have a tendency toward *melancholicus* without quite reaching a positive position in the series of that form. It would be possible to erect a Colombian subspecies for these intermediates, most of which can be distinguished from typical *chloronotus*, but there are too many examples of *chloronotus* which duplicate the Colombian birds to make this desirable. On the whole, therefore, it seems best to extend the range of *chloronotus* to include all of Colombia except the southwest corner while keeping in mind the tendency toward average larger size and average darker mantle of the birds from the Colombian Andes.

Two males from Ciudad Bolívar are very close to *melancholicus* in distinction from other typical *chloronotus* from the same locality. I have little doubt that they are migrant *melancholicus* but they may be only unusual extremes of *chloronotus* or intergrades with *melancholicus* at a point which is near the junction of the ranges of these two forms. For the present, therefore, I have included them with *chloronotus*.

SPECIMENS EXAMINED

T. m. melancholicus.—PARAGUAY: 3 ♂, 2 ♀. URUGUAY: 1 ♂. ARGENTINA: 6 ♂, 5 ♀. BOLIVIA: 9 ♂, 7 ♀, 1 (?). BRAZIL: Estado Rio de Janeiro, 4 ♂, 2 ♀;

São Paulo, 5 ♂, 2 ♀; Paraná, 4 ♂, 1 ♀, 1 (?) ; Espirito Santo, 3 ♂; Rio Grande do Sul, 6 ♂, 3 ♀, 2 (?) ; Matto Grosso, 10 ♂, 6 ♀; Rio Amazonas, Villa Bella Imperatriz, 5 ♂, 4 ♀; Rio Madeira, Borba, 8 ♂, 3 ♀, 1 (?) ; Igarapé Auará, 3 ♂; Rosarinho, 4 ♂, 4 ♀; Santo Antonio de Guajará, 5 ♂, 6 ♀; Tefé, 12 ♂, 9 ♀; Rio Negro, Manaos, 1 ♂; Flores, 1 (?) ; Campos Salles, 5 ♂, 9 ♀; Igarapé Cacao Pereira, 11 ♂, 10 ♀, 2 (?) ; Yavanari, 3 ♂, 1 ♀; Santa Maria, 1 ♂, 3 ♀; Tatú, 1 ♂, 2 ♀; Santa Isabel, 1 ♂; Tinahy, 1 ♂; Yucabí, 4 ♂, 2 ♀; Tabocal, 2 ♂, 5 ♀; Muirapinima, 2 ♂, 1 ♀; Rio Uaupés, Tahuapunto, 1 ♂, 2 ♀; Ianarete, 2 ♂; Rio Surumú, Frechal, 1 ♂; Rio Branco, Ilha Castanhal, 1 ♂, 1 ♀; Caracarahy, 1 ♂. VENEZUELA: Mt. Roraima, Philipp Camp, 1 ♀; Arabupu, 1 ♂; Río Cassiquiare, El Merey, 4 ♂, 5 ♀; Río Huaynia, 2 ♂, 1 ♀; terrain between the Huaynia and the Cassiquiare, 1 ♂, 2 ♀; Río Orinoco, Lalaja, 1 ♂; Esmeralda, 7 ♂, 4 ♀; Mt. Duida, Savana Grande, 5 ♂, 3 ♀; Valle de los Monos, 2 ♂, 2 ♀; Campamento del Medio, 2 ♂, 3 ♀; "Duida," 1 ♂. PERÚ: Puerto Indiana, 11 ♂, 8 ♀; Río Ucayali, Lagarto, 3 ♀; Santa Rosa, 2 ♂; mouth of Río Urubamba, 4 ♂, 1 ♀; Sarayacu, 10 ♂, 3 ♀; Río Tapiche, 1 (?) ; Río Inambari, 1 ♂, 1 ♀; Río Tavera, 1 ♂; Santo Domingo, 3 ♂, 1 ♀; Astillero, 1 ♂, 1 ♀; Candamo, 1 ♂, 1 ♀; Oconeque, 1 ♀. ECUADOR: Río Suno, above Avila, 2 ♂; mouth of Lagarto Cocha, 1 ♂, 2 ♀; mouth of Río Curaray, 4 ♂, 5 ♀. BRITISH GUIANA: 6 ♂, 3 ♀, 2 (?) .

T. m. despotes.—BRAZIL: Bahia, 14 ♂, 4 ♀, 3 (?) ; Ceará, 2 ♂, 1 ♀; Piauí, 4 ♂, 3 ♀; Pernambuco, 2 ♂, 1 ♀; Goyaz, 3 ♂, 3 ♀; Maranhão, 8 ♂, 1 (?) ; Rio Madeira, Calamá, 1 ♀; Porto Velho, 2 ♀; São Lorenzo River, 1 ♂; Pará, Utinga, 1 ♂, 1 ♀; Rio Tocantins, Baião, 2 ♂; Rio Xingú, Porto de Moz, 1 ♂, 1 ♀; Río Tapajoz, Igarapé Brabo, 4 ♂, 4 ♀; Aramanay, 1 ♂, 5 ♀; Limoál, 1 ♂; Santarem, 1 ♂, 1 ♀, 1 (?) ; Río Jamundá, Faro, 6 ♂, 10 ♀. DUTCH GUIANA: 3 ♂, 4 ♀. FRENCH GUIANA: 2 ♂, 2 (?) .

T. m. obscurus.—PERÚ: Palambla, 4 ♂ (incl. type), 1 ♀; Huancabamba, 1 ♂, 3 ♀; San Ignacio, 2 ♂, 4 ♀; Perico, 1 ♂, 2 ♀; Cabico, 1 ♂, 1 ♀; Pomará, 1 ♀; Pucará, 2 ♀; Lomo Santo, 2 ♂, 1 ♀; Seques, 2 ♂, 2 ♀; Huarandosa, 1 ♂; Chachapoyas, 1 ♂, 1 ♀; Río Seco, 2 ♂, 3 ♀; Viña, 1 ♂; Malca, 1 ♂; Platanar, 1 ♀; Choquisongo, 1 ♂; Samate, 1 ♂; Pisco, 1 ♂, 2 ♀; Vitarte, 1 ♀; Huacho, 1 ♂, 2 ♀; Hualar, 2 ♂, 3 ♀; Sullana, 1 ♀; Virú, 5 ♂, 1 ♀; Chuchurras, 1 ♂; Utcuyacu, 2 ♂, 2 ♀; La Merced, 1 ♂, 1 ♀; Perené, 1 ♂, 1 ♀; Tulumayo, 3 ♂, 2 ♀, 1 (?) ; Idma, 1 ♂; Nuevo Loreto, 1 [♂?], [2 ♀?]. ECUADOR: Zamora, 3 ♂, 2 ♀; San Javier, 1 ♂, 1 ♀; Guayaquil, 2 ♂; Chone, 1 ♂, 1 ♀; Paramba, 3 ♂, 1 ♀; Cachabi, 3 ♀; Chimbo, 1 ♂, 1 (?) ; La Piñas, 1 ♂; Isla Tembleque, 1 ♂; Cebollal, 1 ♀; Guainche, 1 ♂; Isla Jambeli, 1 ♀; Intag, 1 ♂; Gualale, 2 ♂; Nanegal, 1 ♂; Esmeraldas, 2 ♀; San Domingo, 1 ♂, 1 ♀; Mindo, 2 ♂; Manaví, 1 ♂; Río de Oro, 1 ♂; Bucay, 1 ♂, 1 ♀; Santa Rosa, 1 ♀; Portovelo, 1 ♂; Alamor, 3 ♀; Zaruma, 2 ♂, 1 ♀; Pullango, 1 ♂. COLOMBIA: Cerro Munchique, 1 ♂; Ricaurte, 2 ♂, 2 ♀; Tumaco, 1 ♂, 1 ♀.

T. m. chloronotus.—MEXICO: Quintana Roo, 2 ♂. GUATEMALA: 36. HONDURAS: 1 ♂. NICARAGUA: 4 ♂, 4 ♀. COSTA RICA: 6 ♂, 7 ♀. PANAMÁ: 32 ♂, 16 ♀. COLOMBIA: (Honda, "Bogotá," Bogotá savanna, Andalucia, Santa Elena, Quibdo, Turbaco, Palmira, San José, Cali, San Antonio, Puerto Valdivia, Las Lomitas, Subia, Mambitto, Calamar, Cundinamarca, Florida, La Holanda, Noanamá, Barro Blanco, Nóvita, San Augustin, La Sierra, Anolaima, El Roble, Choachi, Río Ginu, Dabeiba, Florencia, Aguadita, La Playa, and Baranquilla), 32 ♂, 24 ♀, 2 (?)

(Santa Marta region), 26 ♂, 16 ♀, 3 (?). VENEZUELA: (San Esteban, Cocallar, San Antonio, Cristóbal Colón, Cotiza, Barquismeto, Santa Ana Valley, Rincon San Antonio, Cumaná, Campos Alegre, Mérida region, Altagracia, La Prición, Suapure, Ciudad Bolívar, Quiribana de Caicara, Maripa, Sacupana, Maipures, "Venezuela"), 30 ♂, 27 ♀, 1 (?). TRINIDAD: 9 ♂, 3 ♀. TOBAGO: 4 ♂, 3 ♀. GRENADA: 1 ♂, 2 ♀, 2 (?).

T. m. occidentalis.—MEXICO: San Blas, Tepic, 1 ♂ (type), 2 ♀, 1 (?); Escuinapa, Sinaloa, 4 ♂, 2 ♀, 1 (?); Juana Gomez River, 1 ♂. GUATEMALA: Ocos, 1 ♀.

Empidonomus aurantio-atro-cristatus aurantio-atro-cristatus (D'Orbigny and Lafresnaye)

Tyrannus aurantio-atro-cristatus D'ORBIGNY AND LAFRESNAYE, 1837, Mag. Zool., VII, cl. II, 'Syn. Av.,' p. 45—Valle Grande, Bolivia; Paris Mus.

Tyrannus auriflamma BURMEISTER, 1860, Jour. für Orn., VIII, p. 246—Mendoza, Argentina; cotypes in Halle Mus.

Tyrannus inca SCLATER, 1861, P. Z. S. London, p. 383—Bolivia; British Mus.

There are no Peruvian specimens of this species in the collections of The American Museum of Natural History. Field Museum of Natural History has a young male from Rioja and a female from Yurimaguas, which have been courteously lent to me, and there are other records from Jeberos, Huambo, and "Upper Ucayali" [= near Cashiboya],—two specimens from Jeberos but only a single one from each of the other localities. The Huambo specimen is recorded as collected on March 5; judging by Bartlett's itinerary, the Jeberos skins must have been collected in April or May, and the "Upper Ucayali" skin some time between May and August; the Rioja specimen is dated July 5 and the Yurimaguas bird, September 11.

The Rioja and Yurimaguas examples unquestionably belong to typical *aurantio-atro-cristatus* and there is no reason to doubt that the other Peruvian records refer to the same form. Nevertheless, there is a decided hiatus in the range between the Peruvian localities and the nearest points in Bolivia or Brazil from which there are records during the months between September and March.

I have five examples from four localities on the upper Rio Negro and the Uaupés, in Brazil, and from the upper Orinoco, in Venezuela, which are even farther from the heretofore accepted range of typical *aurantio-atro-cristatus* and represent a new and unexpected extension of distribution of that form to which the specimens undoubtedly belong. The five birds were taken in March, July, August, and September.

Thirty-one specimens from Bolivia, Matto Grosso, Argentina, and Paraguay bear dates between October and February; two others from Bolivia were taken in March and one was obtained in April; one ad-

ditional Matto Grosso skin was collected in August. It is not unlikely that the form is resident in Bolivia and Matto Grosso, but it appears to be absent from at least parts of its breeding range during the southern winter. Wetmore (1926, Bull. U. S. Nat. Mus., 133, p. 337) has recorded it as such in the southern part of its range, and gives inclusive dates of September 15 to February 17 during which time it was found in Paraguay, Uruguay, and Argentina. The dates for the upper Rio Negro and vicinity represent the remaining portion of the year, with very slight overlapping.

It seems fairly obvious, therefore, that the five northern specimens are winter visitants which probably came from Argentina, Bolivia, Paraguay, or Uruguay, and the Peruvian records appear to represent similar migrants from the south.

Of the five birds in hand from the far north, the March specimen is in somewhat worn juvenal plumage, just beginning molt; the July and August skins are in full molt; one September bird has nearly completed its molt and the other September specimen is in full, fresh plumage.

The Rioja bird is a young male in early post-juvenal molt, only a little more advanced than a March bird from the Orinoco. The Yurimaguas female is, I judge, in its first adult dress, with molt all but complete, and quite comparable to a September skin from the Rio Negro.

SPECIMENS EXAMINED

E. a. aurantio-atro-cristatus.—BOLIVIA: "Campos forest," Prov. Sara, 1 ♂, 5 ♀; Chilon, Santa Cruz, 1 ♂, 2 ♀. BRAZIL: Cuyabá, 1 ♂; Chapada, 3 ♂, 2 ♀; Rio Negro, Yucabí, 2 ♂; San Gabriel, 1 ♀; Rio Uaupés, Tahuapunto, 1 ♂. VENEZUELA: Río Orinoco, mouth of Río Ocamo, 1 ♂. PARAGUAY: Fort Wheeler, 1 ♀; Colonia Rizzo, 1 ♂. ARGENTINA: Tucuman, 1 ♀; Tapia, 2 ♂; Barracas al Sud, 1 ♀; La Soledad, 1 ♂; Perico, Jujuy, 1 ♂; Embarcación, 3 ♂; Rosario de Lerma, 4 ♂, 2 ♀; Mocovi, Chaco, 3 ♂. PERÚ: Rioja, 1 ♂¹; Yurimaguas, 1 ♀¹.

E. a. pallidiventris.—BRAZIL: Rio Tapajoz, Santarem, 2 ♂; Maranhão, São Luiz, 1 ♂; São João dos Patos, 2 ♂, 1 ♀; Parnahyba, south of Balsa River, 1 ♂; Ilha São Luiz, Anil, 1 ♂; Piahy, Bello Horizonte, 1 ♂, 1 ♀.

Empidonomus varius varius (Vieillot)

Muscicapa varia VIEILLOT, 1818, 'Nouv. Dict. Hist. Nat.,' nouv. éd., XXI, p. 458—based on AZARA, No. 187; Paraguay.

The present species is in much the same status in Perú as its congener, *E. aurantio-atro-cristatus*. There is a specimen from Pebas in the British Museum; one from Tarapoto (April 5) in the Berlepsch Collection, Frankfort Museum; and a record by Bartlett from the "Upper Ucayali"

¹ Specimens in Field Museum of Natural History, Chicago.

[= near Cashiboya], a bird probably collected between May and August, the present repository of which I do not know. Hellmayr has examined the Tarapoto specimen and includes it in *E. v. rufinus*, but there is great probability that all the Peruvian references should be referred to typical *varius*. The nearest point in the range of *rufinus* is on the Rio Madeira, Brazil, and there are no records between the Madeira and Perú. On the other hand, there is some evidence to show that *varius*, like *aurantio-atrocristatus*, is migratory from the southern part of its range in the South Temperate Zone winter, reaching localities far to the northward and quite possibly entering Perú at that season though probably in very small numbers. A series of Peruvian birds would be necessary to determine the full status of the records from this country.

Thirty-one examples from various localities on the Orinoco, the Casiquiare, the Negro, French and Dutch Guiana, "Bogotá," and adjoining areas, are dark birds, of maximum size, and with the breast and sides, and often the flanks and sides of the belly, quite broadly and heavily striped with brown. Specimens from part of this region have been presumed to represent the form described by Todd as *septentrionalis*. I am unable to distinguish them from thirty-eight skins of typical *varius* from Argentina, Paraguay, eastern Bolivia, and the states of Matto Grosso, São Paulo, Rio de Janeiro, Rio Grande do Sul, and Minas Geraes, Brazil. The thirty-one specimens from the north (except two "Bogotá" skins) are labeled as collected between the months of March and September, most of them between April and August, while the southern birds are dated from late September to February. In addition, thirteen specimens from the lower Rio Madeira, the Rio Tapajoz, and the lower Rio Negro seem also to belong to the typical form in distinction from *rufinus* which is represented by many specimens at hand from the same general region. These thirteen examples are dated March, May, June, and August. In the series from certain nearby localities where collections were made only between October and February (the Rio Tocantins, Faro, Rio Andirá, etc.) only *rufinus* is present.

There is some evidence of the occurrence of both forms at other localities. Five birds from "Celci Puede" [= Salsipuede], Cumaná, Venezuela, belong to *rufinus*; one bird from the same locality is *varius*. A female from Ciudad Bolívar and a male from Agua Salada de Ciudad Bolívar are *rufinus*, but five other Ciudad Bolívar specimens are *varius*. A British Guiana skin is *rufinus* but a "Cayenne" specimen and a Dutch Guiana bird are *varius*. Other conflicts of the same sort are to be seen.

The species has been recorded as nesting in British Guiana and it is

quite probable that *rufinus* does breed in that country and possibly farther to the northwest in Venezuela. It also seems apparent that *varius* enters the same region in the non-breeding season.

I have no topotypes of *septentrionalis* and hence cannot assert that this form is synonymous with *varius* although the type was collected in May and could have been a migrant from the south. The range of variation in the series at hand from the north is coterminous with that of the specimens from Paraguay, Argentina, and southern Brazil, with the darkest northern specimen no darker than the extreme from the south. Possibly *septentrionalis* exists as a still darker form restricted to the Carabobo region of Venezuela.

The blackest-backed specimen of all is an August bird from near Manaos which is in great contrast to a series of *rufinus* from the same region.

The migrants of this form reach their wintering grounds in March in quite worn condition. Some April specimens show the beginnings of molt; most May specimens are in molt and June examples are completing the change. July birds are fairly fresh and there is a certain amount of abrasion through August and September so that the birds arriving in the south in September may be already slightly worn, though much fresher than the January and February examples.

I can find little difference in size between *varius* and *rufinus*. Measurements of both (using specimens of *varius* only from Paraguay, Argentina, and the states of Matto Grosso, Rio de Janeiro, São Paulo, Minas Geraës, and Rio Grande do Sul, Brazil; and of *rufinus* only from the states of Maranhão, Ceará, Pernambuco, and Bahia), the following figures were obtained. Males of *varius*: wing, 96–104 mm. (av., 99.8); tail, 77–85 (av., 80.6). Females of *varius*: wing, 90–101 (av., 96.4); tail, 72–80 (av., 77.5). Males of *rufinus*: wing, 97–100.5 (av., 98.1); tail, 77–84.5 (av., 81.5). Females of *rufinus*: wing, 91–95.5 (av., 93.3); tail, 73.5–82 (av., 76.6).

The preceding evidence leads me to the conclusion that there is greater probability of the migration of *varius* to Perú than of the interrupted extension of the range of *rufinus* to this country. For the present, therefore, I am including the Peruvian records under the typical form.

SPECIMENS EXAMINED

E. v. varius.—PARAGUAY: Trinidad, 1 ♂, 1 ♀; east of Caaguassú, 3 ♂. ARGENTINA: Salta, Embarcación, 1 ♂; Tucumán, 1 ♂; Tafi Viejo, 1 ♂. BOLIVIA: Province of Sara, 1 ♀. BRAZIL: Matto Grosso, Chapada, 6 ♂, 5 ♀, 1 (?); Urucum, 2 ♂, 1 ♀; Belvedere de Urucum, 1 ♂; Rio de Janeiro, Monte Serrat, 2 ♂; São Paulo, São Sebastião, 1 ♂; Fazenda Cayoá, 1 ♂; Ypanema, 1 ♂; Minas Geraës,

Fazenda Emerick, 1 ♂; Rio Grande do Sul, São Pedro, 1 ♂, 1 ♀; São Francisco de Paula, 2 ♀; Nonohay, 1 (?); Paccaria, 1 ♀; Tamandua, 1 ♂.

E. v. varius (migrants ?).—BRAZIL: Rio Tapajoz, Aramanay, 3 ♂, 3 ♀. Igarapé Brabo, 2 ♂, 1 ♀; Rio Madeira, Rosarinho, 3 ♂; Rio Negro, Manaos, 1 ♂; Santa Isabel, 1 ♀; Tabocal, 1 ♂; Rio Uaupés, Ianarete, 1 ♀; Rio Surumú, Frechal, 1 "♂" = ♀. FRENCH GUIANA: "Cayenne," 1 [♀]. DUTCH GUIANA: near Paramaribo, 1 ♀. VENEZUELA: La Florida, Cumanacoa, 1 ♂; "Celci Puede (= Salsipuede), 1 ♀; Caicara, 3 ♂, 2 ♀; Quiribana de Caicara, 1 ♀; Ciudad Bolívar, 2 ♂, 3 ♀; Rio Cassiquiare, mouth of Río Ocamo, 3 ♂, 1 ♀; opposite mouth of Ocamo, 1 ♂; junction of Río Huaynia and Río Cassiquiare, 1 ♂; terrain between Huaynia and Cassiquiare, 2 ♀. COLOMBIA: "Bogotá," 2 [♀].

E. v. rufinus.—BRAZIL: Bahia (no locality), 2 ♂, 3 ♀ (incl. 1 ♂, 1 ♀, cotypes of "*Muscipeta ruficauda* Wied"); Bahia, 2 ♀, 1 (?); Jiquy, 2 ♂; Cajazeiras, 2 ♂; Ceará, Joazeiro, 2 ♂; São Pedro do Cariry, 1 ♂; Pernambuco, Bello Jardim, 2 ♂, 2 ♀; Rio Branco, 1 ♀; Aguas Pretas, 1 ♀; Maranhão, Anil, 4 ♂, 1 ♀; São João dos Patos, 1 ♀; Codó, 1 ♂, 1 ♀; Miritiba, 1 ♂, 1 ♀; São José, Ilha São Luiz, 1 ♂; Pará, Utinga, 2 ♂; Prata, 1 ♀; Igarapé Assú, 1 ♂; Flor do Prado, 1 ♂; Rio Tocantins, Mocajuba, 3 ♂, 5 ♀; Baião, 1 ♂, 1 ♀; Rio Tapajoz, Aramanay, 2 ♂, 1 ♀; Igarapé Brabo, 4 ♂, 2 ♀; Santarem, 2 ♂; Villa Bella Imperatriz, Boca R. Andirá, 2 ♂, 1 ♀; Lago Andirá, 1 ♂, 1 ♀; Serra de Parintins, 1 ♂; Santa Clara, 1 ♀; Rio Madeira, Borba, 1 ♂; Igarapé Auará, 1 ♂; Porto Velho, 1 ♂; Rio Jamundá, Faro, Maracanã, 11 ♂, 10 ♀; Castanhal, 1 ♂; Rio Negro, Manaos, Campos Salles, 2 ♂, 1 ♀; Hacienda Rio Negro, 5 ♂, 2 ♀; Muirapinima, 1 ♂, 1 ♀; Igarapé Cacao Pereira, 6 ♂, 3 ♀. BRITISH GUIANA: Annai, 1 ♂. VENEZUELA: "Celci Puede" (= Salsipuede), 1 ♂, 3 ♀; Ciudad Bolívar, 1 ♀; Agua Salada de Ciudad Bolívar, 1 ♂; Nericagua, 1 ♂, 1 ♀; Quiribana de Caicara, 1 ♂.

Sirystes sibilator albocinereus Sclater and Salvin

Sirystes albocinereus SCLATER AND SALVIN, 1880, P. Z. S. London, p. 156—Bogotá; British Mus.

I have no Peruvian material of this species although *albocinereus* has been recorded from Santa Cruz, Iquitos, "Upper Ucayali" [= Cashiboya], and "Upper Amazons" [= ? near Pebas].

The various forms of the species appear to be comparatively rare wherever found and there is yet much to be learned of their distribution. Among the specimens at hand are several which are of particular interest in view of the extensions of range which they demonstrate.

SPECIMENS EXAMINED

S. s. subcanescens.—BRAZIL: Rio Tocantins, Baião, Pedral, 1 ♂, 1 (?); Rio Tapajoz, Limoal, 1 ♀.

S. s. albogriseus.—PANAMÁ: Tacarcuna, 1 ♂, 1 ♀; Tapalisa, 1 ♂, 1 ♀; Boca de Cupe, 1 ♀; [Lion Hill], 1 (?) (type).

S. s. albocinereus.—COLOMBIA: Barrigon, 1 ♂.

S. s. antimastus.—BRAZIL: Matto Grosso, Chapada, 4 ♂, 2 ♀, 2 (?).

S. s. sibilator.—BRAZIL: "Rio Janeiro," 2 (?); Paraná, Roca Nova, 1 ♂, 1 ♀;

Castro, 1 ♀; Goyaz, Fazenda Esperança, 1 ♂; São Paulo, Fazenda Cayoá, 1 ♀; Victoria, 1 ♂, 3 ♀. PARAGUAY: Sapucay, 1 (?). ARGENTINA: Misiones, Puerto Segundo, 1 ♂, 1 ♀; Santa Ana, 1 ♂. "ECUADOR" (errore !=?); 1 (?).

***Knipolegus poecilurus peruanus* (Berlepsch and Stolzmann)**

Empidochanes poecilurus peruanus BERLEPSCH AND STOLZMANN, 1896, P. Z. S. London, p. 366—Garita del Sol, Perú; ♀; Warsaw Mus.

Peruvian birds for the most part are quite recognizably distinct from Colombian ones, although I have not seen topotypical specimens from the Bogotá region. The Peruvian specimens are decidedly deeper rufous on the under parts than Colombian birds in comparable plumage although worn examples of *peruanus* may have faded to a tone quite comparable to that of fresh *poecilurus* which, in worn condition, is still paler and very similar to *venezuelanus* or even to exceptionally deeply colored examples of *salvini*. The breast in *peruanus* is less strongly gray than in *poecilurus*.

On the upper parts there are less well-defined differences. Very fresh *peruanus* has a faint suggestion of brownish olive on the back in most examples I have seen; *poecilurus* is clearer gray; *venezuelanus* apparently lighter gray (although the type and one additional example are rather worn); and *salvini* darker gray. These characteristics, however, may be found inconstant in larger series.

It would seem that various workers have believed that the sexes of the present species were alike, but if the sexing of the material at hand is correct, with one exception, there is a recognizable difference between them. Adult males of the various forms have the two wing-bars relatively obscure, dull and grayish, without very sharp definition, although always apparent. Furthermore, the upper tail-coverts are relatively grayish like the back, though often with some brownish or dull rufescent edges. Adult females have the wing-bars more prominent, either more whitish or slightly rufescent and the upper tail-coverts are inclined to be more definitely tinged with rufous. The back is usually rather paler than in the average male of the subspecies concerned but the under parts (except in *salvini*) seem to average darker. Young birds of both sexes are like the females except that the wing-bars are still broader and definitely cinnamonaceous or deep buffy; the under parts are somewhat variable. The tail, however, shows a decided reduction in the extent of the black markings, in which respect both sexes of adults are alike. Young *salvini* thus may have the tail marked rather exactly as in adult *poecilurus* and *peruanus* while the young of these forms may have the blackish markings

reduced to a minimum, a character which erroneously formed the basis for the original separation of *peruanus* from *poecilurus*.

I have mentioned that faded specimens of one form may resemble fresher examples of a paler form. Thus the very worn type of "*Knipolegus columbianus*" is very like the type of *E. p. venezuelanus*, which is also somewhat worn, although the latter is rather paler on the back. One of two specimens of *salvini* from Mt. Duida, in very fresh condition, is as deeply colored below but is still darker on the back. Due to this variation, I am in agreement with Chapman (1931, Bull. Amer. Mus. Nat. Hist. LXIII, p. 100) that a specimen from the Rio Içanna, Brazil, assigned by Hellmayr to his *venezuelanus*, probably belongs to *salvini*.

A surprising specimen is one from eastern Bolivia, in worn condition, which is exceedingly like the type of *venezuelanus*. Fresh material from this region will be necessary to determine the identity of the Bolivian bird which is hardly likely to belong to the north-Venezuelan form. Assignment to *peruanus* is not justified by the appearance of this single example which is much paler below than any specimen of the Peruvian form even in quite worn condition.

Ecuadorian birds are intermediate between *peruanus* and *poecilurus* but are rather closer to *peruanus*. There is a slight difference in size between these two forms in which respect, as in general color, the Ecuadorian birds are closer to the Peruvian ones. Colombian males have the wing 78.5 to 79 mm.; Peruvian males, 72-76; Ecuadorian males, 73 and 75.5. Females, 75, 68.5-74, and 70.5-73, respectively.

It is difficult to find adequate characters to entitle this species to unique generic distinction (*Eumyiobius* BRODKORB, 1937, Proc. Biol. Soc. Wash., L, p. 1), although it is properly separable from *Cnemotriccus* to which (under that name or *Empidochanes*) it has been referred by most authors, though sometimes with an expressed doubt of proper affiliation. Its closest relative is *Knipolegus*, as was disclosed by Chapman when he redescribed *poecilurus* as "*Knipolegus columbianus*."

The tail-pattern of *poecilurus* is shown by the females of various species of *Knipolegus*; the general proportions of wing and tail are similar in some species, and the shape of the bill, with its rounded and moderately well-exposed nostrils may be matched fairly closely. It is true that there is usually a greater sexual difference in the members of *Knipolegus* but not always, although the females tend to resemble the dark males while in *poecilurus* the female style of plumage is adopted by both sexes. In *Knipolegus* the tenth (outermost) primary is usually shorter than the fourth while in *poecilurus* it is between the fourth and fifth in length

(rarely shorter than the fourth; Brodtkorb is in error in stating that the tenth equals the second). However, *K. cabanisi* has the wing very similar except that the sixth primary is usually longer than the ninth whereas in *poecilurus* it is usually shorter; *cabanisi* also has somewhat more narrowed primaries, though this feature is not shared by all members of *Knipolegus*. In short, I can find no characters of sufficient value to separate this species from *Knipolegus* to which I believe it should be referred.

I am quite unable to see the relationship connoted by the name *Eumyobius*.

Peruvian records of *peruanus* are from Tambillo, Charapi, Perico, Chachapoyas, Garita del Sol, Auquimarca, Paltaypampa (Junín), San Miguel Bridge, and Cosñipata.

SPECIMENS EXAMINED

K. p. poecilurus.—COLOMBIA: Coast Range west of Popayan, 1 ♂ (type of *K. columbianus*); La Palma, 1 ♂, 1 ♀; La Candela, 1 ♂; near San Augustin, 1 ♂; Santa Elena, 1 ♀; San Antonio, 1 [♂].

K. p. venezuelanus.—VENEZUELA: El Escorial, 1 ♂ (type); La Culata, 1 (?).

K. p. salvini.—BRITISH GUIANA: Roraima, 1 ♂. VENEZUELA: Philipp Camp, Mt. Roraima, 3 ♂, 2 ♀; Rondon Camp, Mt. Roraima, 1 ♂; Central Camp, Mt. Duida, 1 ♂; Cerros de Savana, Mt. Duida, 1 ♂.

K. p. peruanus.—PERÚ: Lomo Santo, 1 ♂, 1 ♀; Chaupe, 5 ♂, 1 ♀; Utcuyacu, 2 ♂, 2 ♀; Nuevo Loreto, 2 ♂; Chinchao, 4 ♂¹, 4 ♀¹. ECUADOR: Guayaba, 1 "♂" (= ♀), 1 ♀; Sabanilla, 1 ♀; Zamora, 2 ♂, 1 ♀.

K. p. subsp ?.—BOLIVIA: "Camp, woods," Prov. del Sara, 1 ♂.

¹ Specimens in Field Museum of Natural History, Chicago.

AMERICAN MUSEUM NOVITATES

Number 963

Published by
THE AMERICAN MUSEUM OF NATURAL HISTORY
New York City

Nov. 18, 1937

STUDIES OF PERUVIAN BIRDS. NO. XXVIII¹

NOTES ON THE GENERA *MYIODYNASTES*, *CONOPIAS*, *MYIOZETETES*, AND *PITANGUS*

BY JOHN T. ZIMMER

I am greatly indebted to Messrs. C. C. Gregg and Rudyerd Boulton of Field Museum of Natural History, Chicago, for the loan of certain critical specimens used in the following study.

Names of colors are capitalized when direct comparison has been made with Ridgway's, 'Color Standards and Color Nomenclature.'

Myiodynastes luteiventris luteiventris Selater

Myiodynastes luteiventris SOLATER, 1859 (May), P. Z. S. London, XXVII, p. 42—"Mexico merid., Guatemala, et America centrali" = Orizaba, Mexico; British Mus.

The arrangement of a series of one hundred and seventy-three specimens of this species has not been easy. The form described as "*swarthi*," from Arizona, is relatively constant in its characters, judging by material at hand, but typical *luteiventris* is more variable and often indistinguishable in individual specimens. Both forms are migratory and occur together in migration over most of the breeding range of *luteiventris* as well as in most of the transient and wintering range of that form, although "*swarthi*" appears to winter farther south than does any true *luteiventris*. This matter is discussed in greater detail below.

Further complications are caused by the fact that the species molts in its winter quarters and that the birds are already in slightly worn plumage when they arrive in their breeding range, becoming progressively more abraded until they reach their southern home again and renew their dress. Very worn specimens of the two forms may be indistinguishable, especially in dorsal coloration, and, in any case, there is considerable difference between the ragged individuals that arrive in South America in the fall and the freshly plumaged birds that are preparing to start north for their nesting grounds. By far the larger part of the specimens at hand from Arizona and northern Central America are intermediate between these two extremes and hence comparable to neither.

¹ Previous papers in this series comprise American Museum Novitates, Nos. 500, 509, 523, 524, 538, 545, 558, 584, 646, 647, 668, 703, 728, 753, 756, 757, 785, 819, 860, 861, 862, 889, 893, 894, 917, 930, and 962.

Taking a series of specimens from the Huachuca Mountains and one skin from the Chiricahua Mountains, Arizona, as typical of "*swarthy*" and comparing it with a similar series of typical *luteiventris* from eastern Mexico, the distinctions of "*swarthy*" are apparent although they are none too positive. The under parts of "*swarthy*" are more consistently pale, apparently never becoming as deeply yellow as some *luteiventris*, although other *luteiventris* are just as pale. The streaking on the under parts of "*swarthy*" is less sharply defined, being of a somewhat browner, less blackish, hue, averaging a little narrower, more frequently reduced to hair lines on the throat and more often decidedly reduced in prominence on the flanks though sometimes strong and well-marked. The upper parts are similarly duller, with the shaft-streaks of the crown averaging narrower and the stripes on the back averaging narrower and less sharply defined, with margins of more buffy, less brownish or cinnamonaceous, tone. The top of the head and back of the neck often have a definite grayish tinge. The outer margins of the greater and median upper wing-coverts are somewhat broader and whiter. The malar stripe reaches a paler and grayer extreme; the cinnamonaceous color of the rump and upper tail-coverts averages paler. Young birds resemble the adults in most of these particulars, differing by the much narrower central stripe on the median rectrices and the stronger striping on the head and back where, however, the pale tips of the feathers break the continuity of the stripes and produce a somewhat spotted appearance. The concealed crest on the top of the head is pale buff or pale cinnamonaceous in the young of both forms, not yellow. The outer margins of the upper wing-coverts are narrower than in the adults and have more strongly ochraceous basal portions.

Worn specimens of "*swarthy*" have the upper surface darkened by the wearing away of much of the pale margins of the feathers, leaving the remainder of such margins faded and more grayish than in fresh skins. Worn *luteiventris* also are darker for the same reason but the faded edges of the feathers may approach the color of fresher specimens of "*swarthy*." The comparative breadth and sharpness of the dark central streaks above and below thus form the best criterion of distinction of the two forms. Faded *luteiventris* may be very pale below (one such specimen from Guatemala is nearly white), but the streaks remain sharper than in "*swarthy*." Nevertheless, some specimens from the apparent breeding range of *luteiventris* are not clearly separable from "*swarthy*."

Using the characters shown by the series here accepted as typical of the two forms, it appears that a series of birds from northwestern Mex-

ico (Sinaloa, Jalisco, Tepic, and Colima) are best referred to the Arizona form, while specimens from the eastern and southern parts of this country (Nuevo Leon, Tamaulipas, Tehuantepec, and Hidalgo) agree with Vera Cruz specimens and must be referred to *luteiventris*. Yucatan birds also belong to *luteiventris*.

Guatemalan and Costa Rican specimens are mostly *luteiventris*, but I have three from each country that are slightly closer to "*swarthi*," two taken in March, one in April, one in middle May, and one in August (one is without date but is a spring bird, judging by the condition of the plumage). All but one of the Nicaraguan birds at hand are *luteiventris*; one March male is closer to "*swarthi*."

I have no evidence of the breeding of the species south of Costa Rica nor of the occurrence of individuals from Costa Rica northward in winter, except a single specimen from "Yucatan, Feby.," without data as to collector, year, sex, or other details. It is, therefore, not to be accepted without some question. Records from South America and Panamá are not numerous. We have two specimens from Panamá (March and September) and one skin from Colombia (October). There is a record from Sarayacu, Ecuador, of a bird collected by Buckley, now in the British Museum. Peruvian records are not numerous but are supplemented by sixteen examples before me. There is one record from Bolivia, supplemented by four additional specimens now at hand. Apparently, therefore, Perú is in the heart of the winter range of the species, if the number of specimens in collections is any criterion.

The two Panamanian birds and the Colombian specimen belong to typical *luteiventris* as do most of the Peruvian skins. Two birds from eastern Perú are somewhat doubtfully referable to "*swarthi*." Both are immature, collected in October, whereas all but one of the remainder of the Peruvian series are adult. Nevertheless, these two young birds are much like young Arizona specimens although one of them is badly worn.

The most important Peruvian specimen is the type of *vicinior* Cory, a young male from near Yurimaguas, collected in October. Careful comparison of this specimen with young birds from Arizona and others from Guatemala leaves little doubt that this specimen is a migrant individual of the Arizona form. Since *vicinior* antedates "*swarthi*" it must become the name of the Arizona subspecies.

The type of *vicinior* is in full juvenal plumage, not greatly worn, and shows no signs of molt. It is even more definitely assignable to the Arizona series than the other two young Peruvian specimens mentioned above. Judging by the date and the fact that even central and south-

east Peruvian skins of later date are referable to *luteiventris*, it may be presumed that the Yurimaguas individual was in transit to some point still farther south and that Yurimaguas is not necessarily in the full wintering region. More material will be required to determine the exact extent of the winter range.

Specimens from southeastern Perú are not as dark as those from central Perú but are not pale enough for *vicinior*. They are fresher than the central Peruvian skins, which accounts for their clearer color, but are comparable to the Bolivian skins from which they can be distinguished on the characters determined for the separation of the two forms.

Four Bolivian specimens, all taken in February, seem to belong to *vicinior*. One of them is definitely of this subspecies. A second is more deeply ochraceous on the margins of the mantle-feathers than any Arizona bird, but the outer borders of the upper wing-coverts are very broad and whitish and the pectoral striping is brownish and dull. The third skin is more heavily striped below but the upper parts, though moderately heavily striped, are relatively pale and buffy on the edges. A longer series would be necessary to determine whether true *luteiventris* reaches Bolivia but the evidence now available indicates that the form breeding farther to the northward, in Arizona, migrates the greater distance to the southward.

I have no theory to account for the extensive migration of *luteiventris*. It breeds within the tropics of the northern hemisphere and migrates to the tropics of the southern continent. Its movements, apparently, are correlated with those of *vicinior* which is found from sea-level up to 8000 feet and breeds at least from southern Sinaloa, Mexico, to the Huachuca Mountains of Arizona, and which evacuates the entire region, tropical and temperate, in August or September, returning in April and breeding in late April and May.

The Peruvian series demonstrates the annual molt as beginning in October or shortly before and terminating in late February. The entire process is thus carried out in winter quarters.

Other Peruvian records are not to be assigned to one subspecies or the other without careful examination of the specimens in question. These are but two. Jelski collected a young male at Monterico (date not given); Stolzmann obtained one male at Yurimaguas on March 14.

Sclater (1888, 'Cat. Birds Brit. Mus.,' XIV, p. 184) considered "*nobilis*" (*sensu lato*) as an intermediate form connecting *luteiventris* with "*audax*" [= *maculatus*] and "passing into its northern and southern representatives at the extremities of its range." There is some justifi-

cation for this belief, although I have seen no specimens which might be considered as intermediates of this character.

There are so many features in common between the *luteiventris* and *maculatus* groups that a common origin can hardly be doubted. The dusky chin of *luteiventris* is the only constant character which distinguishes that species. I have seen no tendency toward the development of such a marking in the *maculatus* group, although the width of the marking is very variable in *luteiventris* and might be expected to disappear entirely in extreme examples. Other characters are shared, either singly or in various combinations, with the members of the *maculatus* group.

The greatest obstacle to the amalgamation of the two groups is the apparent occurrence of both together in certain parts of Central America. There are no records of *maculatus* from Nicaragua or eastern Costa Rica where *luteiventris* exists, and, to this extent, the two species replace each other, but both appear to be found in eastern Mexico, western Costa Rica, and Guatemala. Future field work may uncover some differentiation in habitat or season of which I have no evidence at present, but it is equally possible that the two groups, one resident and one migratory, are definitely separable specifically as at present considered.

Myiodynastes luteiventris *vicinior* Cory

Myiodynastes luteiventris *vicinior* CORY, 1916, Field Mus. Nat. Hist. Publ., Orn. Ser., I, p. 342—Yurimaguas [Puerto Arturo], Perú; ♂; Field Museum Nat. Hist.

Myiodynastes luteiventris *swarthi* VAN ROSSEM, 1927 (March 15), Condor, XXIX, p. 126—Huachuca Mountains, Arizona; ♂; Dickey Coll.

This form is discussed in the preceding pages with the typical form. Three specimens, including the type, all of them immature, constitute the only Peruvian specimens I have seen which can be satisfactorily distinguished from typical *luteiventris*. The winter home is in Bolivia but there is no certainty that the form remains in Perú at this season, since the three specimens may all be migrants to the more southern region. The localities are Puerto Arturo, Perené, and the mouth of the Río Urubamba; the dates of collection are all in October. Bolivian specimens were taken in February.

SPECIMENS EXAMINED

M. l. luteiventris.—MEXICO: Nuevo Leon, Boquilla, 3 ♂, 3 ♀; Vera Cruz, Jalapa, 2 ♂; Orizaba, 1 (?); Potrero, 1 ♂, 1 ♀; Paraje Nuevo, 2 ♂; Tehuantepec, Santa Efigenia, 1 ♀; Tamaulipas, Río Cocono, 1 ♂; Vicotencatl, 1 ♂; Yucatan, Calotmal, 1 (?); "Yucatan," 3 (?). GUATEMALA: Finca Sepacuite,

5 ♂, 1 ♀; Finca Cipres, 12 ♂, 14 ♀, 1 (?); La Perla, 2 ♂, 1 ♀; Secaquim, 1 ♂; Finca Chamá, 2 ♂; Finca La Primavera, 2 ♀; Carolina, 1 ♂, 3 ♀; Hacienda California, 2 ♀; Vera Paz, 1 (?); "Coban to Clusac," 1 (?); "Guatemala," 7 (?). NICARAGUA: Matagalpa, 1 ♂, 1 ♀; Ocotal, 1 ♀; Chinandega, 1 ♂, 1 ♀; Volcán Viejo, 2 ♀; San Rafael del Norte, 1 ♂. COSTA RICA: Aquinares, 2 ♂, 3 ♀; Monte Redondo, 1 ♀; Las Cañas, 1 ♀; Irazú, 1 ♂; Miravalles, 1 ♂, 1 ♀; Navarrito, 1 ♀; Santa Maria de Dota, 2 ♂, 1 ♀. PANAMÁ: Veraguas, Santa Fé, 1 ♂; El Villano, 1 ♂. COLOMBIA: Chicoral, 1 ♀. PERÚ: Río Ucayali, Santa Rosa, 1 ♂; Chanchamayo Valley, Perené, 3 ♂, 4 ♀; Río Colorado, 1 ♂¹, 1 ♀¹; Astillero, 1 ♂, 2 ♀.

M. l. vicinior.—UNITED STATES: Arizona, Huachuca Mts., 8 ♂, 6 ♀; Chiricahua Mts., 1 ♂. MEXICO: Sinaloa, Río Juana Gomez, 2 ♂, 1 ♀; Juan Lisiarraga Mts., 3 ♂, 2 ♀; Jalisco, Wakenakili Mts., 1 ♂, 2 ♀; Sal si Puedes, 1 ♀; Tepic, Rancho San Pablo (Nayarit), 2 ♂, 1 ♀; Guadalajara, 1 ♂; Colima, 1 (?). GUATEMALA: Finca Cipres, 1 ♂; Finca La Primavera, 1 ♀; Carolina, 1 ♂. NICARAGUA: San Rafael del Norte, 1 ♂. COSTA RICA: Aquinares, 2 ♂; (no locality), 1 ♂. PERÚ: Puerto Arturo, Yurimaguas, 1 ♂¹ (type); Perené, 1 ♀, mouth of Río Urubamba, 1 ♂. BOLIVIA: Tres Arroyos, Espíritu Santo, 1 ♂, 1 ♂¹; Province of Sara,

Myiodynastes maculatus maculatus (Müller)

Muscicapa maculata P. L. S. MÜLLER, 1776, 'Natursyst.,' Suppl., p. 169—Cayenne.

Muscicapa audax GMELIN, 1789, 'Syst. Nat.,' I (2), p. 934—based on DAUBENTON, 'Pl. Enl.' 453, fig. 2; Cayenne.

It is rather unfortunate that the name, *maculatus*, is based on the Cayenne bird since the Cayenne population appears to be not as constant as could be desired. In general, it seems to be more closely allied to the Amazonian population than to any other and I have, accordingly, adopted the name for the subspecies which inhabits the Amazonian lowland region from Faro and Monte Alegre, on the north bank of the great river, and Pará and western Maranhão, south and east of its mouth, westward to eastern Perú and eastern Ecuador, with a possible hiatus on the lower Tapajoz, Xingú, and Tocantins rivers.

This form is characterized by its small bill which is relatively short, relatively narrow, and relatively evenly tapered in front of the nostrils. The under parts are only moderately heavily streaked, with the stripes not as dark nor as sharply defined as in some other forms, although they are more prominent than in *M. m. nobilis* of the Santa Marta region. The throat is usually finely streaked and there is a wash of yellow on the breast, sides, flanks, and under tail-coverts which is as well developed as in any other form, more so than in some others, including *nobilis*. The back is varied with dusky brown centers on the feathers and pale mar-

¹ Specimens in Field Museum of Natural History, Chicago.

gins which sometimes are quite brownish but which average more buffy or even decidedly grayish; the top of the head is correspondingly warmer or grayer brown but is not so strongly rufescent as in *nobilis* and some other forms.

The French and Dutch Guianan specimens are rather more heavily marked above and more sharply striped below than most of the Amazonian ones, but they agree fairly well in these particulars with Amazonian extremes and have the bill also of the same general size and shape, though at the maximum for this series. It seems best, therefore, to refer the Amazonian birds to typical *maculatus*.

I have no specimens of this form from the Tapajoz nor any locality farther east. It has been recorded from the Pará district and from Miritiba, Maranhão, but the possibilities are that it has reached this area across the islands in the mouth of the Amazon; it has been found, for example, on Mexiana and Caviana. On the other hand, I have skins from Villa Bella Imperatriz, both banks of the lower Rio Madeira, Teffé, localities on both sides of the Amazon in Perú, and Ecuador. Furthermore, I can find no records from the Tapajoz, Xingú, or Tocantins valleys. The situation in this limited area is particularly interesting and is discussed in detail under *M. m. solitarius* on a later page.

There is a single record of "*audax*" from Iquitos, collected by Whitely.

Birds from British Guiana, Venezuela, Trinidad, and Tobago have been referred by numerous authors to *maculatus*, but in the series at hand they appear to be recognizably distinct, forming a subspecies which finds its strongest expression in the population of the island of Tobago. This form may be known as follows.

Myiodynastes maculatus tobagensis, new subspecies

TYPE from Mariah, Tobago Island. No. 496,463, American Museum of Natural History (Rothschild Collection). Adult male collected May 12, 1903, by E. André's collectors.

DIAGNOSIS.—Similar to *M. m. maculatus* of French and Dutch Guiana and the Amazonian region, but averaging whiter below, with less yellowish suffusion on the breast, sides, flanks, and under tail-coverts; pectoral and gular stripes broader, darker, and sharper; under tail-coverts averaging more heavily streaked; upper surface darker, with the dark centers broader and more dusky and the pale edges narrower and less conspicuous; wing and tail longer; bill longer and heavier; dark shaft-stripes of tail averaging broader.

RANGE.—Tobago, Trinidad, the northern coast of Venezuela west to northern Anzoategui, southeastward across the Orinoco Delta into British Guiana.

DESCRIPTION OF TYPE.—Crown with margins of the feathers Brussels Brown and with shaft-stripes of blackish; this pattern restricted to the distal part of the

feathers, the basal portion of which is Lemon Chrome, tinged with cadmium centrally and passing into whitish laterally, forming a concealed patch; forehead buffy whitish streaked with brown; mantle with centers of feathers very broadly dusky brown, edged with brownish buff; hind neck slightly warmer, passing into the color of the tips of the crown-feathers; uropygium with margins of the feathers brighter, passing into Cinnamon-Rufous on the smaller upper tail-coverts and dark Sanford's Brown on the longer ones, with the dark central stripes progressively narrower. A moderately conspicuous superciliary stripe pale Cream-Buff, streaked with brown, passing narrowly over the lores and connecting with the pale forehead; lores blackish; auriculars dusky brown with whitish bases; a broad malar stripe of buffy whitish, reaching to the base of the bill, separated from the throat by a narrower stripe of dark brown, somewhat more blackish on the shafts of the feathers; throat white, rather conspicuously streaked with dark brown; breast and sides similar, with streaks much broader; flanks lightly tinged with pale yellow and with streaks somewhat duller but still prominent; middle of belly white; under tail-coverts Marguerite Yellow, strongly striped with light brown. Wings dull fuscous brown, with outer margins of the primaries light Auburn; outer margins of secondaries light buff, broader on the inner feathers and much broader and whiter on the tertials; greater upper wing-coverts with outer feathers margined exteriorly with Cinnamon-Rufous, the succeeding feathers with some buff toward the tips, and the inner ones with the outer margins yellowish buff; median coverts somewhat similar but with less buff at the tips of the feathers; lesser coverts with the outer feathers margined with cinnamonaceous, the inner feathers grading into the color of the mantle; under wing-coverts Barium Yellow with some narrow, dark streaks except along the carpal border where the streaks are very broad, leaving only a narrow border of yellow; axillars Barium Yellow, with conspicuous brown shaft-streaks; inner margins of remiges pale yellow on the secondaries, tinged with orange-buff on the primaries. Tail with broad shaft-stripes of sooty black and with inner margins dark Sanford's Brown \times Auburn, about half the width of the outer web on the median quills and about six-tenths of the width of the outer pair; outer margins of rectrices broadly rufescent except on outer pair where the margin is inconspicuously buffy. Maxilla and distal third of mandible (in dried skin) blackish; basal portion of mandible dull flesh-color; feet dusky brown. Wing, 109 mm.; tail, 84.5; exposed culmen, 24; culmen from base, 29.5; tarsus, 20.5.

REMARKS.—Female similar to the male in color but averaging smaller. Wing, 102–110.25 (σ , 104.5–115); tail, 81–89 (σ , 81–93).

This form also is not perfectly uniform. It reaches its best development on the island of Tobago, for which reason Tobago was chosen as type locality. Trinidad birds are nearly as well marked and some of the specimens from the mainland are characteristic, but there is a tendency toward other forms exhibited by various specimens which increases as the ranges of these forms are approached (cf. account of *M. m. difficilis*). On the other hand, a specimen from Sacupana, at the mouth of the Orinoco, is well-marked *tobagensis* as are two skins from British Guiana; two other British Guiana birds are not so well marked but are not ref-

erable to typical *maculatus* and evidently represent no more than a light extreme of the Tobago form.

This form, of the various forms usually considered as subspecies of *maculatus*, approaches *solitarius* most closely, although it does not intergrade or hybridize with it. Certain abraded specimens show this resemblance the best. It is due to the heavy striping on the under parts, including the throat, and the heavy dorsal markings with narrow, pale borders which produce an effect of linear stripes of broad blackish and narrower whitish color. The relatively broad central stripes of the rectrices also show a certain approach in the direction of *solitarius* although that form, in a pure state, is definitely at a greater extreme than *tobagensis* in its maximum development of this nature.

So far as I can learn, *tobagensis* is resident where found.

Myiodynastes maculatus difficilis, new subspecies

TYPE from Bebedero, Costa Rica. No. 390,975, American Museum of Natural History. Adult male collected February 25, 1922, by Austin Paul Smith.

DIAGNOSIS.—Similar to *M. m. nobilis* of the Santa Marta region of northern Colombia, but pectoral striping heavier and more sharply defined; possibly a slightly stronger tinge of yellow on the under parts; throat and under wing-coverts averaging more strongly streaked. Coloration most like that of *M. m. maculatus* of French and Dutch Guiana and the Amazonian region but averaging warmer on head and back; bill notably heavier.

RANGE.—Western Costa Rica, Panamá, and most of Colombia (excepting the Santa Marta region and the extreme northern coast near the mouth of the Río Magdalena); apparently eastward to Mérida, Carabobo, and the middle Orinoco, Venezuela.

DESCRIPTION OF TYPE.—Top of head with blackish shaft-streaks and Sudan Brown margins; forehead and a narrow superciliary stripe more buffy and more narrowly streaked; center of crown with a concealed patch of Light Cadmium, turning to whitish on the bases of the lateral and posterior feathers; hind neck Sudan Brown with relatively strong, dark shaft-stripes; back with broad, but not sharply defined, central spots of dusky brown, blacker at the shafts, margined with a paler hue which is near Isabella Color on the upper mantle and pales to light Buffy Olive on the rump; upper tail-coverts Cinnamon-Rufous X Sanford's Brown with blackish shaft-stripes, broadest on the anterior feathers. Lores sooty blackish; auriculars dusky brown; a broad malar stripe of yellowish white, bordered below by a second stripe of buffy brown with darker shaft-stripes; chin and throat white, with prominent shaft-streaks of dark brown, broadest on the lateral feathers; breast and sides washed with Citron Yellow and broadly striped with Olive-Brown, these stripes continued a little more narrowly but less sharply-defined along the flanks and still more narrowly over the sides and upper part of the belly; a relatively small area in the center of the lower belly immaculate and with a fainter tinge of yellow; under tail-coverts light Primrose Yellow, prominently streaked with brown along the shafts.

Wings Hair Brown; primaries, except outermost, narrowly margined with light Brussels Brown; secondaries with outer margins Light Brownish Olive, paler and more buffy toward the tips and becoming generally whiter and broader on the innermost secondaries and on the tertiaries; median and greater upper wing-coverts with outer feathers margined exteriorly with bright Cinnamon-Rufous which becomes duller and more buffy on the middle feathers and more whitish on the inner ones; lesser series edged with deeper cinnamon; under wing-coverts and axillars Citron Yellow with brown shaft-streaks, broader along the carpal margin; a small grayish brown area with cinnamomeous-edged feathers near the base of the primaries; inner margins of remiges dull buffy yellow. Tail dark Hazel, with moderately broad shaft-stripes of blackish. Bill (in dried skin) blackish brown on maxilla and tip of mandible; remainder of mandible dull whitish; feet dusky brown. Wing, 111 mm.; tail, 89; exposed culmen, 24; culmen from base, 28.5; tarsus, 20.

REMARKS.—Female similar to the male.

A very few Santa Martán birds may be matched with the most lightly streaked examples of *difficilis* but none of them is as heavily marked as the average *difficilis* nor is any specimen of *difficilis* at hand as lightly marked as the average *nobilis*. Taken in series, the differences are quite evident and most of the specimens individually are equally recognizable.

The bill of *difficilis* is distinctly larger than that of *maculatus*. In *maculatus*, the culmen from base measures 24–27 mm., average, 25.5; the width of bill at anterior end of nostrils is 8–11 (one specimen at each extreme, the remainder 9–10), average 9.5. In *difficilis*, the culmen from base is 25.5–30.5, average, 27.3; width of bill at anterior end of nostrils, 10–12.75 (one specimen at each extreme, the remainder are 10.5–12.5, mostly 11–12), average, 11.4. In *maculatus* the bill is more evenly tapered from base to near tip, but in *difficilis* there is greater width continued in front of the nostrils, with more abrupt narrowing near the tip. This large, heavy bill is found in most of the forms of the species, but not in *maculatus*.

Specimens from the middle area of the Orinoco, the Mérida region, and the state of Carabobo, Venezuela, are referred here with some hesitation. They are not quite typical. The upper parts are about equally warmly colored but the pectoral markings are not quite so bold though they may be matched in some of the Colombian and other specimens. The bill, furthermore, is at the minimum of size, although it is rather larger than in the Amazonian *maculatus*. Although not very sharply defined, the pectoral stripes are broader than in *nobilis* and association does not appear to be with that form. The relationship appears to be correlated rather exactly with the geographical position of the region, where the ranges of *maculatus*, *tobagensis*, *difficilis*, and possibly *nobilis* are most nearly centered in common.

Myiodynastes maculatus chapmani, new subspecies

TYPE from Esmeraldas, western Ecuador. No. 118,753, American Museum of Natural History. Adult male collected November 23, 1912, by William B. Richardson.

DIAGNOSIS.—Nearest to *M. m. difficilis* of Costa Rica, Panamá, and central Colombia, but differing from it (as also from all other forms of the species) by the unusually broad and clear superciliary stripe most of which is unstreaked; pectoral stripes a little heavier than in *difficilis*.

RANGE.—Extreme western Ecuador and probably the coast of northwestern Perú.

DESCRIPTION OF TYPE.—Crown with blackish central streaks and Brussels Brown margins at the tips of the feathers, concealing a basal patch of Lemon Chrome in the center of the area; forehead rather broadly Cream Color with inconspicuously darker shaft-streaks; this pale area continued rather broadly over the lores and broadening still further over the orbits and auriculars where it is more whitish (Ivory Yellow), unstreaked except in a narrow line over the auriculars, and noticeably white subbasally; mantle with broad, dusky brown centers, edged with light brown or buff (light Buckthorn Brown to Naples Yellow); upper tail-coverts rufescent (bright Hazel), with somewhat buffy margins and broad central stripes of dusky on the upper feathers, clearer rufous margins and narrow shaft-streaks on the longer ones. Lores blackish; auriculars dark brown; a broad malar stripe of buffy whitish, bordered below by a narrower stripe of dark brown, passing into whitish anteriorly; chin and throat white, streaked with dark brown on the shafts, narrowly in the center, more broadly laterally; breast whitish, tinged with pale yellow and with moderately heavy shaft-streaks of dark brown, somewhat broader on the sides; flanks Reed Yellow, with narrow, dull shaft-streaks of brown, much less conspicuous than the pectoral markings; under tail-coverts Reed Yellow with hair-like shaft-streaks of brown. Wings dark Hair Brown; outer margins of primaries on basal half near Sayal Brown; outer margins of outer secondaries basally Saccardo's Umber, paler distally and more whitish toward tips; on inner secondaries and tertials the margins are broader and slightly yellowish white; upper wing-coverts with strong outer margins which are light cinnamonaceous on the outer feathers, becoming whitish on the inner feathers of the greater and median series; under wing-coverts and axillars Barium Yellow with fine, brownish shaft-streaks, broader toward the carpal margin of the wing; inner margins of secondaries pale, dull yellow; inner margins of primaries tinged with buff. Tail Cinnamon Rufous \times Sanford's Brown with broad, blackish shaft-stripes occupying less than half of the inner web of the median pair and about one-fifth of the inner web on the outer pair, proportionately narrower on the outer webs of the various rectrices except the outermost where the rufous outer margin is only poorly defined. Bill (in dried skin) with maxilla and tip of mandible blackish; remainder of maxilla dull whitish; feet blackish. Wing, 108 mm.; tail, 83; exposed culmen, 24; culmen from base, 29.5; tarsus, 19.

REMARKS.—Female similar to the male; not certainly different in size or color.

I am unable to find any specimens in the large series of the *maculatus* group now available, except those from the western coastal region of

Ecuador, which exhibit such a prominent superciliary stripe as forms the principal diagnostic character of *chapmani*. In *solitarius* the stripe is prominent but part of the effect is due to the blackness of the surrounding parts against which the white stripe stands in contrast. All of the forms of *maculatus* have a superciliary stripe of sorts but it is always relatively narrow and often obscured by the prominence of the shaft-streaks on the individual component feathers. In *chapmani* the stripe may be four or five millimeters in width, without streaking. In young birds the superciliary is usually as prominent as in the adults but one specimen from the coast of Manaví is very like some *maculatus* in corresponding plumage.

The single record of "*nobilis*" from Lechugal, Perú, undoubtedly belongs to *chapmani*.

I take great pleasure in naming this form for Dr. Frank M. Chapman who needs no introduction to students of South American birds.

***Myiodynastes maculatus solitarius* (Vieillot)**

Tyrannus solitarius VIEILLOT, 1819, 'Nouv. Dict. Hist. Nat.,' nouv. éd., XXXV, p. 88—based on AZARA, No. 196; Paraguay.

Myiodynastes solitarius duncani CHUBB, 1919, Bull. Brit. Orn. Club, XL, p. 62—Supenaam, British Guiana; British Mus.

It is rather difficult to find complete evidence on the dates of occurrence of *solitarius* in various localities, but such data as are available indicate that this bird is found only as a migrant on the Amazon and in all areas north of that stream. The series of over sixty specimens at hand from the Amazon and northward is dated from March 25 to September 16 (except for two specimens dated in November and December but which are of much earlier origin, judging by the condition of molt, described hereafter). Wetmore (1926, Bull. U. S. Nat. Mus., No. 133, p. 332) records the arrival of this bird in Paraguay on September 20; no data are given as to possible dates of departure from the south. Nevertheless, an average nesting season would allow the birds until February or March to leave their breeding range in the southern countries and to form, thereby, the necessary missing link in the yearly complement of dates.

The breeding range in Brazil appears to embrace suitable localities from as far south as Rio Grande do Sul, north along the coastal series of states to Piahy, and west through Goyaz to Matto Grosso. Maranhão specimens at hand are dated October, April, and May, and Hellmayr records others dated September and June. In this state, therefore,

the bird is evidently a winter resident or visitor, but it is uncertain that it breeds there. Our Piauhyskins are June birds while Hellmayr records December, which indicate the presence of the bird in that state both in the breeding and winter seasons. We have June birds from Bahia which must, therefore, be included in the winter range as well as the breeding area. Pinto's records from southern Goyaz include only August, October, and November. All birds that I have seen from Minas Geraes and Matto Grosso, Brazil, eastern Bolivia, and all areas south of this, including Uruguay, Paraguay and northern Argentina are dated from August to April, most of them from September to March. There is thus a considerable region from which *solitarius* may migrate after its breeding season. A record by Natterer from Ypanemá in June conflicts with this suggestion, although Natterer states that the bird is not found in Rio de Janeiro in winter.

Nowhere does the breeding range appear to touch that of the Amazonian *maculatus*; at least such contact is not demonstrable in the material examined. Nevertheless, a series of seven birds, six from the right bank of the lower Xingú and one from Villa Bella Imperatriz, are intermediate between these two forms. These birds are dated March, August, and September and possibly are migrants from some other locality to the southward. Twenty-two skins from both banks of the Tapajoz, dated March, April, May, June, and July, are typical *solitarius* as are four birds from the lower Madeira and all other specimens from the winter range of this form.

As mentioned in the discussion of *maculatus*, there are no records of the Amazonian form from the Tapajoz, Xingú, or Tocantins, and it is possible that *solitarius* replaces it as a resident and breeder in this area, but the dates of our material are all between those of departure and re-arrival in the more southern breeding areas, suggesting that *solitarius* reaches the Amazon only as a winter visitor. The origin of the intermediate specimens is, therefore, impossible to determine with the material now available.

We have one specimen of *solitarius* said to have been collected on the lower Tocantins (Baião) in November, but the specimen is still in the concluding stages of molt which our extensive series from other localities show in a similar stage in June and July. The date and locality are, therefore, to be questioned since the collector of this bird was not on the Tocantins in June or July. A similar error is evident in a specimen from the lower Napo, Ecuador, said to have been taken in December although the plumage indicates June as the probable date. The re-

mainder of the series, including another eastern Ecuadorian specimen, appear to be consistently regular. There is no positive evidence, therefore, that *solitarius* breeds in the Pará region or in southeastern Ecuador.

The intermediate specimens from the Xingú are not uniform in all particulars, showing more individual variation than typical *solitarius* but about the same amount as *maculatus*. The upper parts are dark without being as blackish as in *solitarius*, although several specimens have much the same kind of linear, olive-whitish edging on the back; others are near the pattern of *maculatus*. The throat averages more heavily streaked than in *maculatus*, less heavily than in *solitarius*. The rest of the under parts are whitish suffused with yellow on breast and flanks and with yellowish under tail-coverts; the center of the belly is unstreaked as in *maculatus*; the pectoral striping is more pronounced than in most *maculatus* but not so heavy as in *solitarius*. The tail shows various degrees of intermediacy. It is not like typical *solitarius* in any of the intermediate birds. One example has this appendage of the same color and pattern as in *maculatus*; two specimens have the same pattern, but the rufous hue is deeper; three have the blackish shaft-stripe widened so as to occupy more than half of the inner webs on all of the feathers. In *maculatus* this shaft-stripe frequently occupies more than half of the width of the inner web on the middle rectrices, but, apparently, never so on the outer feathers. In *solitarius* there is frequently a very narrow rufous inner margin on the rectrices, wider toward the tip and wider in young birds, but it does not reach the development shown by the intermediate skins under discussion.

The intermediates have the bill of the size shown by *maculatus* and both larger and smaller (culmen from base, 23–28 mm.), as does *solitarius*, and the pattern of the wing, with very fine, dark rufescent margins on the primaries, etc., in better agreement with *solitarius* than with *maculatus*. When the series is placed between one of *solitarius* and one of *maculatus*, the intermediate nature of these birds is apparent at a glance.

Sclater (1888, 'Cat. Birds Brit, Mus.,' XIV, p. 186) notes that intermediates occurred between *solitarius* and "*audax*" which were very difficult to arrange satisfactorily under either form and suggested that the relationship was probably a subspecific one. Hellmayr (1927, Field Mus. Nat. Hist. Publ., Zool. Ser., XIII, Pt. 5, p. 127, footnote a) considered this suggestion unfavorably since he had never seen intermediates. In the light of the present evidence I have adopted Sclater's proposal even though the exact origin of the intermediate birds may be still undetermined.

Records of *solitarius* from Perú are from Huaynapata, Garita del Sol, La Gloria, La Merced, Borgoña, Tarapoto, Monterico, Chayavitas, Jeberos, Yurimaguas, Chirimoto, Moyobamba, Chamicuros, Pebas, and an unspecified region of hot forests and plantations (presumably the Chanchamayo Valley). Others are given below in the list of material examined.

Dates are not available for all of these records. All recorded dates from northern Perú are in March, April, June, July, and August. Nevertheless, Bartlett (in Sclater and Salvin, 1873, P. Z. S. London, p. 280) notes that he obtained one egg of this bird. Presumably this was from Yurimaguas, Jeberos, Chayavitas, or Chamicuros, but Bartlett does not specify locality or date. His skins from these localities were dispersed and are not available for examination. Consequently I have no confirmation of his record and no data from northern Perú to substantiate it. Further information on this point is much to be desired.

The case is otherwise in central and southeastern Perú. I collected a male and a young female on the Río Colorado, Chanchamayo Valley, in February and January, respectively. There is a specimen from Perené, collected in October, and a record from Garita del Sol, also October. Specimens from southeastern Perú are dated September and October. The January and February occurrence indicates the breeding of *solitarius* in this part of the country and a specimen from Tulumayo, taken in May, suggests that the residence here is permanent, although it is not impossible that the breeding and "wintering" populations are different.

There are no records of *maculatus* from central or southeastern Perú nor, for that matter, from anywhere in the Huallaga Valley or westward. Hence, even if *solitarius* should be found to breed in this area, it would not be proof of any conflict in the ranges of these two forms. The Ucayali specimens of *solitarius* were taken in March, April, and July, and are non-breeding birds; hence the occurrence of *maculatus* on the Ucayali at the same time does not imply a significant conflict in distribution.

SPECIMENS EXAMINED

M. m. maculatus.—FRENCH GUIANA: Cayenne, 4 ♂, 1 ♀; "Cayenne" (trade-skins), 2 (?). DUTCH GUIANA: Paramaribo, 1 ♂, 3 ♀. BRAZIL: Monte Alegre, 1 ♂; Faro, 1 ♂; Rio Negro, Igarapé Cacao Pereira, 2 ♂; Rio Madeira, Borba, 1 ♂; Igarapé Auará, 3 ♂, 2 ♀; Rosarinho, 5 ♂, 7 ♀; Santo Antonio de Guajará, 2 ♂, 1 ♀; Villa Bella Imperatriz, 2 ♂, 1 ♀. ECUADOR: mouth of Río Curaray, 1 ♂, 4 ♀. PERÚ: Anayacu, 1 ♀; Sarayacu, 1 ♂, 3 ♀; mouth of Río Urubamba, 1 ♀.

M. m. tobagensis.—TOBAGO: Mariah, 2 ♂ (incl. type); Castare, 3 ♂; Englishman's Bay, 1 ♀; "Tobago," 1 ♂. TRINIDAD: Princetown, 3 ♂, 1 ♀; heights of Aripo, 2 ♀; Caparo, 4 ♂, 4 ♀; Valencia, 1 ♀; Pointe Gourde, 1 ♀; "Trinidad," 1 (?). VENEZUELA: Cristóbal Colón, 2 ♂, 2 ♀, 1 (?); Puerto La Cruz, 1 ♂; El Pilar, 1 (?); San Antonio, Bermúdez, 1 ♂; Rincon San Antonio, 2 ♂; San Estéban, 1 ♀; Las Quiguas, 1 ♂; Sal si Puede, 2 ♂, 1 ♀; Quebrada Secca, 1 ♂; Plain of Cumaná, 1 ♂; Santa Ana Valley, 1 ♂; Cumanacoa, 1 ♀; Yacua, Gulf of Paria, 1 (?); Sacupana, 1 (?). BRITISH GUIANA: Annai, 1 ♀; Essequibo River, 1 (?); Rupuruni River, 1 ♂, 1 ♀.

M. m. nobilis.—COLOMBIA: Santa Marta, Minca, 3 ♂, 1 (?); Bonda, 4 ♂, 6 ♀, 6 (?); Cacagualito, 4 ♂; "Sta. Martha," 3 ♂; Río Magdalena, Calamar, 1 ♂; Puerto Berrio, 1 ♂, 1 ♀.

M. m. difficilis.—COSTA RICA: Bebedero, 2 ♂ (incl. type), 1 ♀; Miravalles, 3 ♂, 1 ♀; Pigres, 1 ♂; El Pozo, 1 ♀; San José, 1 ♂. PANAMÁ: Santa Fé, Veraguas, 7 ♂, 6 ♀; Wilcox Camp, 1 ♂; El Villano, 1 ♂; Agua Dulce, Coclé, 1 ♂; La Colorado, Santiago, 1 ♂, 2 ♀; Cape Mala Peninsula, 1 ♂; Boqueron, Chiriquí, 2 ♂; Bogava, 1 ♀; Río Capeti, 1 ♂, 1 ♀; Savanna near Panamá, 1 ♂; Tocumé, 1 ♂, 3 ♀; Chepigana, 1 ♂; El Real, Río Tuyra, 1 ♂, 3 ♀; Tarcarcuna, 1 ♀; Coiba Island, 3 ♂, 1 ♀; Pearl Islands, Pedro Gonzalez, 1 ♂, 5 ♀; Pearl Islands, Pacheco, 1 ♀; [Lion Hill?], 1 ♂, 1 ♀. COLOMBIA: Palmira, 2 ♂; Alto Bonito, 2 ♂; Puerto Valdivia, 2 ♀; Chicoral, 2 ♀; Malena, 1 ♂; Dabeiba, 1 ♂; San Isidro, 1 ♀; Río Caquetá, 1 ♀. VENEZUELA: Tachira, Ortiza, 1 ♂, 1 ♀; Mérida, Escorial, 1 ♂; Ejido, 1 (?); Carabobo, Las Trincheras, 2 ♂; Quiribana de Caicara, 3 ♂, 1 ♀; Caicara, 2 ♂; Ciudad Bolívar, 1 ♀; Suapure, 1 ♀.

M. m. insolens.—MEXICO: Jalapa, 1 ♂; Yucatan, 1 ♂, 1 (?). GUATEMALA: Finca Chamá, 3 ♂, 1 ♀; "Guatemala" (trade-skins) 3 (?).

M. m. chapmani.—ECUADOR: Esmeraldas, 4 ♂ (incl. type), 3 ♀; coast of Manaví, 1 ♀, 2 (?); Chone, 2 ♀; Daule, 1 ♂, 1 (?); Paramba, 1 ♂; Carondelet, 1 ♂; San Javier, 1 ♀; Santa Rosa, 1 ♂, 2 ♀.

M. m. solitarius.—ARGENTINA: La Soledad, 1 ♂; Tucumán, 2 ♂, 1 ♀; Perico, Jujuy, 1 ♂; Embarcación, Salta, 6 ♂, 3 ♀; Santa Ana, Misiones, 1 ♀; Isla Martin Garcia, Río de la Plata, 1 ♂; El Carrizal, 1 ♀¹; Río Paraná. Misiones, 1 ♂¹. URUGUAY: Quebrado de los Cuervos, 4 ♂¹, 1 ♀¹. PARAGUAY: Colonia Risso, 1 ♀, 1 (?); east of Caaguazú, 2 ♂, 3 ♀; east of Yhú, 1 ♀; east of Villa Rica, 3 ♂; Abai, 1 ♂; Asco, 1 ♂. BRAZIL: Matto Grosso, Chapada, 2 ♂, 3 ♀; Urucum, 2 ♂, 1 ♀; Rio Grande do Sul, Nonohay, 1 ♂, 3 ♀, 5 (?); Lagoa Vermelha, 3 ♂; Lagoa de Forno, 2 ♂; Sinimbú, 1 ♂; Sananduva, 1 ♂, 2 ♀; São Francisco de Paula, 4 ♂, 1 ♀; Santa Catharina, Palmitas, 1 (?); Paraná, Roca Nova, 3 ♂, 1 ♀; Tibagy, 1 ♀; Curytiba, 1 ♂; Corvo, 2 ♂; Porto Almeida, 2 ♂; São Paulo, Alambary, 2 ♂; Fazenda Cayoá, 2 ♂; "Rio," 2 (?); Monte Serrat, Itatiaya, 1 ♀; Minas Gerais, Pirapora, 1 (?); Bahia, Bahia, 1 ♂, 1 ♀; Santa Ritta, 1 ♂; Orobó, 1 ♂; Jiquy, 3 ♂; Cajazeiras, 1 ♂; "Bahia" (trade-skin), 1 (?); Pernambuco, Rio Branco, 1 ♀; Bello Jardim, 1 ♀; Ceará, Joazeiro, 1 ♂; Piauí, Parnaíba, 1 ♂; Corrente, 1 ♀; Maranhão, Flores, 1 ♂; As Mangueiras, 1 ♂; Itapaca, 1 ♂; Ilha São Luiz, 1 ♂; "Brasil," 1 (?); "S. Brazil," 1 (?); Pará, Benevides, 1 ♂; Utinga, 1 ♂; Rio Tapajós, Aramanay, 5 ♂, 1 ♀, 1 (?); Igarapé Brabo, 5 ♂, 4 ♀; Caxiricatuba, 1 ♀; Tauary,

¹ Specimens in Field Museum of Natural History, Chicago.

1 ♂, 1 ♀; Igarapé Amarin, 1 ♂; Santarem, 1 ♂, 1 (?); Rio Madeira, Igarapé Auará, 1 ♂; Rosarinho, 2 ♂, 1 ♀; Rio Amazonas, Tefé, 3 ♂, 1 ♀; Rio Negro, Manaus, 2 ♀; Tatá, 1 ♂; Rio Uaupés, Ianaeté, 1 ♂, 1 ♀; Tahuapunto, 1 ♂; Rio Surumú, Frechal, 1 ♀. BRITISH GUIANA: Rupuruni River, 1 ♀; Supenaam, 1 (?). VENEZUELA: Río Cassiquiare, Solano, 2 ♂, 1 ♀; Río Huaynia, junction of Cassiquiare, 2 ♀; San Antonio, Bermúdez, 1 (?). COLOMBIA: "Bogotá" (trade-skin), 1 (?). ECUADOR: "Napo," 1 (?); Río Suno, above Avila, 1 ♂. PERÚ: Pozuzo, 1 (?); Tulumayo, 1 ♂; Perené, 1 ♂; La Pampa, 1 ♂; Río Tavera, 1 ♀; Pomará, 1 ♂; Río Seco, 4 ♂, 1 ♀; Sarayacu, 3 ♀; "Perú," 2 (?); Río Colorado, 1 ♂¹, 1 ♀¹; Vista Alegre, 1 ♂¹. BOLIVIA: Province of Sara, 4 ♂, 1 ♀; Monos, 1 ♂; Buena-vista, Santa Cruz, 2 ♂¹.

M. m. solitarius × *maculatus*.—BRAZIL: Rio Xingú, Porto de Moz, 1 ♂, 1 ♀; Tapará, 2 ♂, 2 ♀; Rio Amazonas, Villa Bella Imperatriz, Santa Clara, 1 ♀.

Conopias cinchoneti cinchoneti (Tschudi)

T(yrannus) Cinchoneti TSCHUDI, 1844 (May), Arch. Naturg., X (1), p. 272—Perú = highlands of Junín; Berlin Mus.

There is just enough difference observable between Peruvian and Colombian specimens to reopen the question of recognition of *icterophrys* [*T(yrannula) icterophrys* LAFRESNAYE, 1845, Rev. Zool., VIII, p. 341—Bogotá]. Peruvian birds have the forehead broadly yellow, back to the anterior border of the orbits, whereas Colombian specimens examined have this pale band narrower and decidedly duller, with the single exception of a "Bogotá" skin which at first glance appears to agree with the Peruvian birds. However, this specimen has lost many of the frontal feathers and the anterior plumes of the yellow superciliary stripe appear to be continuous with the yellow bases of the anterior, central feathers of the crown and to give a false impression of a broader band than actually exists. Although this specimen may show the maximum amount of yellow on the forehead for a Colombian specimen, I believe that it is still to be associated with the other Colombian specimens. Also, there is an average difference in the length of the wing which should be significant. Colombian males at hand have the wing 79.5, 81, 82, 82.25, and 82.75 mm.; females 78.75 and 79. A Peruvian male measures 86.75; two females, 82 and 79 (right wing 79, left wing 76). Two Ecuadorian males agree with Peruvian specimens in regard to the wide frontal band and have the wing 84.75 (juvénal) and 88 mm., respectively. The type of *cinchoneti* (without given sex) is said by Hellmayr to have the wing 86.5 mm. Furthermore, Chapman (1921, Bull. U. S. Nat. Mus., No. 117, p. 96) remarks that a male of *cinchoneti* from Idma, Perú, was considerably larger than Colombian specimens, although he gives no measurements.

¹ Specimens in Field Museum of Natural History, Chicago.

It seems evident, therefore, that there is enough distinction here to warrant the recognition of *icterophrys* from Colombia and to restrict the range of *cinchoneti* to Perú and Ecuador.

Sclater (1888, 'Cat. Birds Brit. Mus.,' XIV, p. 173) was in error in stating that there is no yellow-head-spot in the genus *Conopias*. The males of the present species (except one from Río Lima, Colombia, and a young male from Baeza, Ecuador) have a small but distinct yellow patch on the anterior crown. It is rather pale in the Colombianf males and poorly developed in the adult from Baeza, while in the Peruvian male the patch is quite extensive and deeper yellow than in the other birds. The patch is lacking in all the females.

The same condition prevails to a lesser extent in the allied *C. trivirgata*. Various males of both the typical form and *C. t. berlepschi* have small but noticeable yellow crown-patches; the females do not.

It may be remarked here that *berlepschi* has a very much wider range than has been suspected. We have material from Faro, both banks of the lower Río Negro (Hacienda Río Negro and Igarapé Cacao Pereira), the Río Tapajoz (Igarapé Amorin, Caxiricatuba, and Tauarý), the Río Madeira (Borba, Igarapé Auará, and Rosarinho), Villa Bella Imperatriz, and Teffé.

The young male of *c. cinchoneti* from Baeza, Ecuador, has fine, whitish tips on the crown and nape, similar but duller pale tips on the middle of the back and posteriorly, increasing in width posteriorly and becoming brownish buff on the upper tail-coverts. The upper wing-coverts also are tipped with brownish buff and there are narrow pale margins completely encircling each of the rectrices. The pale outer margins of the secondaries are paler and sharper than in the adults.

Curiously, Sclater (1888, t. c., p. 41) included a reference to Tschudi's description under "*Sisopygis*" (= *Satrapa*) *icterophrys* and on that basis recorded that species from Perú, quite erroneously. The reference to Tschudi is repeated under its proper heading on a later page (p. 174).

SPECIMENS EXAMINED

C. c. cinchoneti.—PERÚ: Tulumayo, 1 ♂; Pozuzo, 1 ♀; Río Seco, west of Moyobamba, 1 ♀. ECUADOR: Baeza, 2 ♂.

C. c. icterophrys.—COLOMBIA: Río Lima, 2 ♂, 1 ♀; Aguadita, 1 ♂; La Frijolera, 2 ♂; east of Palmira, 1 ♀; "Bogotá," 1 (♂ ?).

Myiozetetes similis similis (Spix)

Muscicapa similis SPIX, 1825, 'Av. Bras.,' II, p. 18—part; "Fl. Amazonum"; Munich Mus.

M(yiozetetes) similis connivens BERLEPSCH AND STOLZMANN, 1906, ORNIS, XIII, p. 87 (in text)—Santa Ana, Urubamba, Perú; ♂; Warsaw Mus.

An extensive series of birds from the Amazon and another from various localities in eastern and southeastern Brazil show quite clear distinctions that indicate the previous misapplication of Spix's name, *similis*. The southeast-Brazilian birds all have a definite brownish hue of olive on the upper parts, whereas the Amazonian specimens are greener. The outer margins of the remiges average a little stronger rufous and the throat and superciliary region a little clearer white, but there is too much individual variation to make these features as definitive as the color of the back. Old and faded specimens from the Amazonian region are rather browner than fresh ones and approach the fresher examples of the southeast-Brazilian series, but when fresh examples from both regions are compared, the difference is quite apparent.

Hellmayr [1906, Abh. K. Bayer. Akad. Wiss., 2 Kl., XXII (3), p. 649] noted that the cotype of Spix's *similis* which belongs to the present group (the other belongs to *M. cayanaensis*) and to which he (l. c.) restricted the name, was badly soiled. It is very probable that, due to this fact and to the age of the skin, exact determination at the present time would be impossible and the geographic position of the type locality would, therefore, be of major importance. In assigning it to the subspecies which included east-Brazilian examples, Hellmayr included also specimens from the Rio Madeira and eastern Perú. The Peruvian skins have since been assigned to the form described as *connivens*. Careful comparison of the series of Amazonian birds now at hand with other specimens from Perú reveals the fact that the Amazonian series also must be referred to the east-Peruvian subspecies. Accepting Spix's citation of the Amazon River as type region, *connivens* must fall as a synonym of *similis*. For greater accuracy, I propose the mouth of the Rio Madeira as restricted type locality, visited by Spix October 15, 1819. The southeast-Brazilian form must then be known as *M. s. pallidiventris* PINTO (1935, Rev. Mus. Paulista, XIX, p. 212—Reconcava, Bahia).

The range of typical *similis* thus may be considered to involve both banks of the Amazon from the Tapajoz, on the south bank, and Monte Alegre, on the north bank, west to Perú (east of the western Andes), eastern Ecuador, and eastern Colombia, south to northern Bolivia, east (in the north) to the upper reaches of the Orinoco in Venezuela, including at least the western foot of Mount Duida (Río Cunucunumá). The range ascends the Rio Negro from Manáos at least as far as Tauapessasu, but I have no specimens to indicate that it follows up the Negro to the

Cassiquiare and across to join the area near Mt. Duida, as it might be expected to do. I have only the congeneric *M. cayennensis* from the upper Negro, the Cassiquiare, and Mt. Duida itself.

Similarly, I have only one specimen of *similis* from the lower Tapajoz (Igarapé Brabo, left bank), none from the Xingú, and none from the Tocantins. Records from Pará may well belong to *pallidiventris*.

Records from Perú which belong to typical *similis* are from Yurimaguas, Iquitos, Bellavista, Chanchamayo, Santa Ana, Huiro, Cosñipata, Monterico, Upper Ucayali [= Cashiboya], Lower Ucayali, and La Merced. Additional records are from some of the localities from which material has been examined.

Some of the specimens from the westernmost localities in the range of *similis* approach *grandis* in the depth of the yellow ventral color but otherwise are easily referable to *similis*.

***Myiozetetes similis grandis* Lawrence**

Myiozetetes grandis LAWRENCE, 1871 (Dec. 5), Proc. Acad. Nat. Sci. Phila., p. 234—Prov. Tumbes, Perú; Vassar College.

Myiozetetes similis pacificus CHAPMAN, 1924 (Oct. 18), Amer. Mus. Novit., No. 138, p. 2—Santa Rosa, Prov. del Oro, Ecuador; ♂; American Museum of Natural History.

This western form has the under parts the most deeply yellow of all the conspecies and the throat and superciliary stripes the most strongly tinged with yellow. The pale wing-bars are relatively well developed, being stronger than in *similis* but weaker than in the maximum of *columbianus* which it most nearly resembles. Its average size is larger than either *columbianus* or *similis* although there is some overlap.

The form is relatively limited in distribution, being found only in western Ecuador and extreme northwestern Perú. Aside from the type from the Province of Tumbes and the specimens listed below, there are no other Peruvian records.

I am unable to adopt Nelson's and Peters's usage of "*Tyrannus superciliosus* BONAPARTE" for the east-Mexican and northern Central American subspecies, to supplant *Muscicapa texensis* GIRAUD (cf. Nelson, 1900, Auk, XVII, p. 124; Peters, 1929, Bull. Mus. Comp. Zool., LXIX, p. 447). I believe it obvious that Bonaparte was merely misidentifying *Tyrannula superciliosa* SWAINSON as is indicated by his quoting "Swains." as authority for the name. That he continued so to misidentify it is evidenced by the fact that in the 'Consp. Gen. Av.,' I, p. 190, 1850, he places Spix's *Muscicapa similis* as a probable synonym of "*T(yrannula) superciliosa* Sw." His diagnosis of "*Tyrannus superciliosus*

Swains." is comparable to the diagnoses of various other species in the same paper ascribed to one author or another and not considered as new; the new forms are identifiable by the accompanying "Nob." The real *Tyrannula superciliosa* SWAINSON is *Conopias trivirgata* (WIED) which has enough points of general resemblance to a *Myiozetetes* to explain Bonaparte's error, especially when faulty descriptions and illustrations of that day are considered. Article 31 of the International Rules of Zoological Nomenclature appears to cover the case in its provision that names based on an error of identification cannot be retained for the misdetermined species.

SPECIMENS EXAMINED

M. s. similis.—BRAZIL: Rio Tapajoz, Igarapé Brabo, 1 ♀; Villa Bella Imperatriz, 5 ♂, 6 ♀; Rio Madeira, Borba, 4 ♂; Igarapé Auará, 2 ♂, 1 (?) ; Rosarinho, 9 ♂, 8 ♀; Santo Antonio de Guajará, 1 ♂, 3 ♀; Teffé, 14 ♂, 5 ♀; Rio Jamundá, Faro, 5 ♂, 8 ♀; Monte Alegre, 1 ♀; Rio Negro, Campos Salles, Manáos, 1 ♂, 3 ♀; Igarapé Cacao Pereira, 12 ♂, 7 ♀; Muirapinima, 2 ♂, 3 ♀; Tauapessasu, 1 ♂. BOLIVIA: Todos Santos, 1 ♀. PERÚ: Rio Tavera, 2 ♂, 1 ♀; Astillero, 1 ♂; Idma, 1 ♂; Pozuzo, 1 ♀; Perené, 2 ♂, 3 ♀; mouth of Rio Urubamba, 1 ♂, 1 ♀; Santa Rosa, 6 ♂, 5 ♀; Sarayacu, 1 ♀; Orosa, 1 ♂, 2 ♀; Puerto Indiana, 2 ♀; Anayacu, 3 ♂; Nauta, 1 ♂, 1 ♀; Perico, 2 ♂, 1 ♀; San Ignacio, 3 ♂, 2 ♀; Rio Negro, west of Moyobamba, 1 ♀; Rio Seco, 2 ♂; Jaen, 2 ♂, 1 ♀; Huarandosa, 1 ♂; Rio Tapiche, 1 (?) ; Moyobamba, 6 ♂¹, 2 ♀¹; Chinchao, 1 ♂¹, 2 ♀¹; Vista Alegre, 2 ♂¹. ECUADOR: Ambato, 1 (?) ; Zamora, 2 ♂; Rio Suno, above Avila, 3 ♂, 1 ♀; mouth of Rio Curaray, 3 ♂, 2 ♀; "Equateur," 1 (?). COLOMBIA: Villavicencio, 3 ♂; Buena Vista, 1 ♂; La Morelia, 1 ♂; "Bogotá," 2 (?). VENEZUELA: San Fernando, upper Orinoco, 1 ♂; mouth of Rio Chanaro, Rio Caura, 1 (?).

M. s. pallidiventris.—BRAZIL: (state of) Minas Gerais, 1 ♂, 1 ♀; Santa Catharina, 3 ♂, 1 ♀; Piahy, 4 ♂, 1 ♀; Espirito Santo, 2 ♂, 2 ♀; Ceará, 1 ♂; Pernambuco, 2 ♂, 2 ♀; São Paulo, 1 ♂, 1 ♀; Rio de Janeiro, 1 ♂, 2 ♀, 1 (?) ; Bahia, 5 ♂, 4 ♀, 5 (?) .

M. s. grandis.—PERÚ: Paletillas, 1 ♂, 1 ♀; Milagros, 1 ♂. ECUADOR: Santa Rosa, 3 ♂ (incl. type of *pacificus*), 1 ♀; Rio Pindo, 1 ♂, 1 ♀; Cebollal, 2 ♀; Zaruma, 1 ♀; Esmeraldas, 2 ♂, 1 ♀; Casanga, 2 ♂; La Chonta, 1 ♂; Chone, 1 ♂; Rio Pullango, 1 ♂; Alamor, 1 ♀.

M. s. columbianus.—VENEZUELA: Ciudad Bolívar, 2 ♂, 3 ♀; Agua Salada de Ciudad Bolívar, 2 ♂; Caicara, 1 ♂; San Fernando, Apure, 1 (?) ; Altagracia, 3 ♂, 3 ♀; (Orinoco trade-skin), 1 (?) ; Salsipuede, 2 ♂, 3 ♀; Campos Alegres, Cumaná, 3 ♂, 1 ♀; Santa Ana Valley, 1 ♂; Cumbre Chiquitos, 1 ♂; Plain of Cumaná, 1 ♀; Guiria, 1 (?) ; San Esteban, 1 (?) ; Puerto Cabello, 1 ♂, 1 ♀; Cristóbal Colón, 1 ♀; Las Trincheras, Carabobo, 3 ♂; Cumanacoa, 3 ♂; El Latal, 1 ♂; Cuchivano, 1 ♂; La Florida, Cumanacoa, 1 ♂; Cocallar, 1 ♂; El Pilar, Anzoategui, 1 ♂; Tucacas, Falcón, 1 ♂, 1 ♀; El Cuji, Lara, 1 ♂; Mérida, 1 ♂; Nevados, 1 ♂; El Valle, 7 ♂, 4 ♀, 2 (?) . COLOMBIA: Andalucía, 1 ♂; Magdalena River, 1 ♀;

¹ Specimens in Field Museum of Natural History, Chicago.

Chicoral, 2 ♀; "Bogotá," 5 (?); Santa Marta, 3 ♂, 1 ♀, 1 (?); Bonda, 3 ♂, 1 ♀, 2 (?); Minca, 1 ♂; Cacagualito, 1 ♂, 1 (?); Buritaca, 1 ♂. PANAMÁ: 19 ♂, 14 ♀, 3 (?). (incl. type of *marginatus*). COSTA RICA: Buenos Aires, 2 ♂; El Pozo, 3 ♂.

M. s. texensis.—COSTA RICA: San José, 1 ♂, 1 (?); Aquinares, 1 ♂, 1 ♀; Guapiles, 2 ♂; Ontario, 1 ♂; Las Cañas, 1 ♀; Carrillo, 1 ♀; Bebedero, 2 ♂; Miravalles, 1 ♀; Atalanta, 1 ♂; Aguas Calientes, 1 ♂, 1 (?). HONDURAS: Chamelicon, 1 (?). NICARAGUA: Matagalpa, 1 ♂; Corinto, 1 ♂, 1 ♀; Chinandega, 1 ♀; Vizagua or Río Tuma, 1 (?); Río Grande, 1 ♂; Tipitapa, 1 ♂. GUATEMALA: 68 skins. MEXICO: [states of Vera Cruz, Jalapa, Tamaulipas, and Yucatan (Peninsula ?)]: 9 ♂; 10 ♀, 6 (?).

M. s. primulus.—MEXICO: Sinaloa, Escuinapa, 4 ♀; Jalisco, Tonila, 1 ♂; Ixtlan, 1 ♂; Guadalajara, 3 ♂, 1 ♀, 1 (?); Chapada, 1 [♂], 1 (?); Tepic, Río Ameca, 1 ♀; San Blas, 1 ♀; Colima, Hacienda Nogueras, 1 ♀, Colima, 1 ♀.

Myiozetetes granadensis obscurior Todd

Myiozetetes granadensis obscurior TODD, 1925 (July 15), Proc. Biol. Soc. Wash., XXXVIII, p. 95—São Paulo de Olivença, Brazil; ♂; Carnegie Mus.

All the Peruvian birds at hand belong to this dark form. I have seen no specimens from Tumbes whence there is an isolated record which Hellmayr has assigned to typical *granadensis* along with birds from western Ecuador and western Colombia. I am unable to follow this assignment. Our series of birds from western Colombia and western Ecuador agree almost exactly in color with *obscurior* but match *granadensis* in size. The difference in size between the two forms is appreciable in both sexes but is more marked in the males. Thus, *granadensis* males have the wing 85.25–91.5 mm.; *obscurior*, 89–96.75; west-coast birds, 85.5–88.5. It is impossible to refer the west-coast specimens either to *granadensis* or to *obscurior* without weakening the characters, either of size or color, which distinguish the two forms. I believe, therefore, that a new subspecies should be recognized from this region as described below.

Records from Perú which belong with *obscurior* are from Tarapoto, Yurimaguas, Cosñipata, and Yahuar Mayo.

Myiozetetes granadensis occidentalis, new subspecies

TYPE from Barbacoas, southwestern Colombia. No. 117,977, American Museum of Natural History. Adult male collected August 12, 1912, by William B. Richardson.

DIAGNOSIS.—Darker above than *M. g. granadensis* of southern Central America and with a greater suffusion of yellow on the throat and a lesser average amount of white on the forehead. Similar in color to *M. g. obscurior* of the Amazonian side of the Andes and the upper Orinoco region, but size smaller, like *granadensis*.

RANGE.—Western side of the Andes in Colombia and Ecuador and, presumably, extreme northwestern Perú, and easternmost Panamá.

DESCRIPTION OF TYPE.—Forehead narrowly dull whitish; remainder of exposed portions of top of head Deep Grayish Olive, tinged with Yellowish Olive and with rather strong dusky brown shaft-streaks; the area immediately behind the forehead clearer gray; center of crown with a large, concealed patch of Flame Scarlet which pales through yellow to whitish on the periphery; back Olive-Citrine with definitely contrasting central areas of brown which are not entirely concealed by the overlapping olive tips and margins; upper tail-coverts dull brown, with narrow light buffy brown margins. Lores sooty brownish, the color passing under the eye and involving most of the auricular region; malar area, chin, and throat whitish, strongly tinged with yellow; center of breast, sides, flanks, belly, and under tail-coverts bright Lemon Chrome; sides of breast dark Olive-Citrine. Wings dark brown with outer margins of remiges (except outermost primary) Citron Yellow, narrow on primaries, broader on inner secondaries; greater upper wing-coverts with Citron Yellow outer margins; median series with margins of duller yellow around the tips; lesser series with still duller and more olive terminal margins; inner margins of remiges dull, pale yellow; under wing-coverts Strontian Yellow. Tail dark brown with narrow outer margins Buffy Citrine, nearly obsolete on outermost pair. Bill (in dried skin) blackish; feet brownish black. Wing, 85.5 mm.; tail, 66; exposed culmen, 13; culmen from base, 16.5; tarsus, 17.5.

REMARKS.—Female much like the male in general coloration but smaller and without the scarlet crown-patch or with a very few feathers of a duller red. Wing, 80.5–82 mm.; tail, 61–69.

This form is, in a sense, intermediate between *granadensis* and *obscurior* but its characters are not individually intermediate ones. It presents, therefore, a new combination of certain characters of the other forms, not intrinsically new characters. Geographically, it is relatively isolated. From *obscurior* it is separated by the heights of the Andes; from *granadensis* it appears to be separated by the whole of eastern Panamá. I have no specimens or records of true *granadensis* farther east than the Canal Zone which is the type locality of that form. Bangs and Barbour (1922, Bull. Mus. Comp. Zool., LXV, p. 218) record a male and female from Jesusito, near Mt. Sapo, eastern Panamá, which they found to be like western Colombian birds rather than like Canal Zone specimens. Evidently the Jesusito skins also belong to *occidentalis*.

In this form, as in *obscurior*, the gray of the top of the head is darker and duller than in *granadensis*; the whitish forehead seems never to reach as great an extreme of broad, silvery white as in the Central American form; the darker olive of the back is rendered still darker by the effect of dark mottling from the centers of the feathers.

As in the related subspecies, young birds differ from adults by generally duller hues except that the borders of the remiges and their upper coverts are cinnamomeous instead of yellow and that the rectrices are

encircled by similar cinnamonaceous margins. Neither sex in this plumage has a scarlet crown-patch.

Judging by analogy and geographical position, the record of *granadensis* from Tumbes, Perú, must belong with this new form.

SPECIMENS EXAMINED

M. g. granadensis.—NICARAGUA: Los Sabalos, 1 ♂, 2 ♀. COSTA RICA: Boruca, 1 ♀; Puerto Jimenez, 1 ♂; Limón, 1 ♂, 1 ♀; Palmar, 1 ♂. PANAMÁ: [near Lion Hill], 1 ♂, 1 ♀ (eotypes of *granadensis*); Almirante, 5 ♂, 2 ♀; Boqueron, 1 ♂, 1 ♀; Bogava, 1 ♀; Río Trinidad, above Cuchirbo, 1 ♀; El Banco, Chiriquí, 1 ♂; Gatun, 2 ♂, 1 ♀; Afuera Island, 1 ♀.

M. g. occidentalis.—COLOMBIA: Alto Bonito, 2 ♀; Juntas, 1 ♀; Barbacoas, 1 ♂ (type); San José, Cauca, 1 ♀; Bagado, 1 ♂. ECUADOR: San Javier, 2 ♂, 2 ♀; Cachabí, 1 ♀; Nanegal, 1 (?).

M. g. obscurior.—COLOMBIA: "Bogotá," 2 [♂], 1 [♀]; Villavicencio, 1 ♀; Mambito, 1 ♀. VENEZUELA: Boca de Sina, Río Cunucunumá, 1 ♀; La Prición, Río Caura, 1 ♂. ECUADOR: below San José, 1 ♂, 3 ♀; Río Coca, 1 ♀; Coca, Río Napo, 3 ♂; Macas, 1 ♂; mouth of Río Curaray, 1 ♂, 1 ♀. PERÚ: Río Seco, west of Moyobamba, 1 ♂, 1 ♀; Juanjui, 1 ♀; Orosa, 2 ♀; Sarayacu, 1 ♂, 1 ♀; Lagarto, 2 ♂, 2 ♀; Santa Rosa, 3 ♂, 1 ♀; mouth of Río Urubamba, 2 ♂, 3 ♀; Astillero, 1 ♂; La Pampa, 1 ♀; Río Tavera, 1 ♂; Perené, 1 ♂, 1 ♀. BOLIVIA: Todos Santos, 1 ♂, 1 ♀.

Pitangus sulphuratus sulphuratus (Linnaeus)

Lanius sulphuratus LINNAEUS, 1766, 'Syst. Nat.,' ed. 12, I, p. 137—based on BRIS-SON, 1760, 'Orn.,' p. 176, Pl. XVI; Cayenne.

Corvus leucogaster BODDAERT, 1783, 'Tabl. Pl. Enl.,' p. 15—based on DAUBENTON, 'Pl. Enl.,' 249; Cayenne.

Corvus flavus GMELIN, 1788, 'Syst. Nat.,' I (1), p. 373—based on DAUBENTON, loc. cit.; Cayenne.

Peruvian birds appear to be inseparable from Cayenne specimens as well as from other examples in a series of two hundred and thirty specimens from various parts of the ascribed range. This range follows the south bank of the Amazon eastward to the right bank of the Tapajoz and perhaps to Pará, crosses the Amazon to Faro and Monte Alegre, and passes northward to the three Guianas, ascends both banks of the Rio Negro to near the mouth of the Uaupés, and extends northward from eastern Perú to eastern Ecuador.

Hellmayr [1927, Field Mus. Nat. Hist. Publ., Zool. Ser., XIII (5), p. 152] has assigned specimens from Boavista and Serra da Lua, Rio Branco, to *sulphuratus*, but a female from Frechal, Rio Surumú, and two of the same sex from Limão, Rio Cotinga, upper affluents of the Branco, belong to *trinitatis*. It may be noted here also that *trinitatis* occurs on the mainland of Venezuela at Guiria, Paria Peninsula, and El

Pilar (Province of Sucre). Two specimens from Ayacucho (Río Orinoco), Venezuela, are far from typical *rufipennis* although they appear to represent the extreme of variation in that form in the direction of *sulphuratus*.

As a matter of fact, all of the Orinocan specimens (excluding those from the region of the mouth of that stream which cannot be separated from *trinitatis*), are at one end of the range of variation while the Santa Martan specimens are at the other. Birds from near the type locality of *rufipennis* (Caracas, Venezuela) are exactly intermediate. The Santa Martan birds are very rufescent on the upper surface; the Orinocan examples are grayer; the Ayacucho birds are decidedly gray, with hardly a tinge of rufous on the back, although the amount of rufous in the wings and tail is as in other examples of this form. Certain specimens of *trinitatis* have a nearly equal amount of rufescence in the wings, including Trinidad examples, but they are exceptions. If Caracas and other north-Venezuelan birds could be assigned clearly to the Santa Martan or Orinocan series, it might be feasible to recognize two subspecies where now only one may be distinguished with certainty. The Colombian birds from the upper Magdalena, including some of the trade-skins from "Bogotá," have a slight tendency toward a duller, less rufous, tone on the back than lower Magdalena examples which agree with Santa Martan birds.

The two skins from Villavicencio, eastern Colombia, discussed by Chapman (1917, Bull. Amer. Mus. Nat. Hist., XXXVI, p. 462) still remain unassignable to any recognized form unless to *trinitatis*. The supposedly sharper definition between the rufous and blackish areas of wing and tail, in comparison with *trinitatis*, proves to be of inconstant value since it falls within the individual variation of a series of *trinitatis*. Unfortunately, there is a wide area between Villavicencio and the nearest point from which *trinitatis* is known and a very narrow region through which any connection could exist without interruption. As stated above, the two available specimens from Ayacucho, on the upper Orinoco, seem to be intermediate between *rufipennis* and *sulphuratus* and do not suggest *trinitatis*. The upper Rio Negro is occupied by true *sulphuratus* with no observable tendencies in any particular direction. If the Villavicencio birds are *trinitatis*, as the evidence indicates, the line of connection, if it exists, must pass somewhere near the boundary of Brazil and Venezuela, through the Cassiquiare region, and across eastern Colombia to the foot of the eastern Andes, an area from which there is no record of the species whatever.

There are traces of a dusky shaft-streak on the primaries of some "Bogotá" specimens, but hardly more than in various examples of *rufipennis* from other parts of its range. All the "Bogotá" birds, therefore, are assignable to *rufipennis* and none to *trinitatis*. A series from extreme eastern Colombia might show some clear distinction from *trinitatis* in birds from that region, but at present I am unable to find a satisfactory character. If the peculiarities of the Villavicencio birds are due to transition toward *sulphuratus* from *rufipennis*, it has taken a different course from that followed on the upper Orinoco and may prove to be an additional link in the chain of evidence suggesting the subspecific separation of Orinocan and Colombian representatives of *rufipennis*. More material is needed to unravel the taxonomic tangle here in evidence.

Additional Peruvian records of *sulphuratus* are from Tarapoto, Pebas, and Moyobamba.

In a comparative study of the Central American forms of the species, I am unable to recognize *palliatius* (van Rossem, 1937, Proc. Biol. Soc. Wash., 4, p. 25—Alamor, Sonora, Mexico) as distinguished from *derbianus*. In fact, *guatemalensis* Lafresnaye, is clearly distinguishable only when the range is allowed to include Costa Rica, Nicaragua, and western Panamá, especially the last-named area. Many Guatemalan birds may be matched by Mexican and Texan examples. There may be some uncertainty with regard to *pallidus* (Griscom, 1930, Amer. Mus. Novit., No. 414, p. 4—Sacapulas, Guatemala). The type and unique example is in molt and the freshly acquired feathers appear to be similar to corresponding ones in *guatemalensis*, while the older, worn plumes may not be distinguished from similar worn feathers in some skins from other parts of Guatemala. As exception to this generalized statement, the under tail-coverts are distinctly paler and less yellowish than in any other Guatemalan bird, worn or fresh, and there may be other differences which would be apparent in a fully freshly plumaged example. Consequently, *pallidus* may be recognized provisionally until its validity can be successfully either substantiated or disproved.

The distinctions between *sulphuratus* and *maximiliani* and between *maximiliani* and *bolivianus* are not sharply delimited. From eastern Perú along the south bank of the Amazon to the east bank of the Tocantins, there is no clear divergence toward *maximiliani*. As pointed out by Hellmayr, however, various birds from southeastern Brazil closely approximate typical *sulphuratus* although the average is fairly distinct. On the other hand, typical *bolivianus* from the Bolivian highlands is easily distinguishable from *maximiliani*, but there is a broad

area of intergradation in which the population is variously intermediate between the two extremes. I follow Hellmayr, therefore, in his delimitation of the distributional areas of these two forms, although the line is somewhat arbitrarily drawn.

SPECIMENS EXAMINED

P. s. derbianus.—UNITED STATES: Texas, Brownsville, 37; Hidalgo, 1; Lomita, 2. MEXICO: 58.

P. s. guatemalensis.—GUATEMALA: 30. COSTA RICA: 5. NICARAGUA: 3. PANAMÁ: Almirante, 8; Cocoplum, 8.

P. s. pallidus.—GUATEMALA: Sacapulas, 1 ♂ (type).

P. s. caucensis.—COLOMBIA: Cali, 7 ♂ (incl. type), 2 ♀; La Florida, 1 ♂.

P. s. rufipennis.—VENEZUELA: Cotiza, Caracas, 1 ♂, 1 ♀; Barquisimeto, Lara, 3 ♂; Las Trincheras, Carabobo, 1 ♀; Cumaná, 1 (?); San Antonio, Bermúdez, 1 ♂; Cumanacoa, 1 ♀; San Estéban, 1 (?); Campos Alegre Valley, 1 ♂; plain of Cumaná, 1 ♀; Cuchivano, 1 ♂; La Florida, Cumanacoa, 1 ♂; Río Orinoco, Ciudad Bolívar, 6 ♂, 1 ♀; Altagracia, 1 ♂, 6 ♀; Caicara, 2 ♂, 1 ♀; Quiribana de Caicara, 1 ♀; Ayacucho, 2 ♂. COLOMBIA: Santa Marta, 3 ♂, 1 ♀, 1 (?); Bonda, 2 ♀, 1 (?); Carthagena, 2 (?); La Playa, 1 ♂, 1 (?); Calamar, 3 ♂; "N. Antioquia," 6 (?); within 20 miles of Honda, 1 ♂; Chicoral, 1 ♂; Honda, 1 ♂; Andalucia, 1 ♂; "Bogotá," 9 (?).

P. s. trinitatis.—TRINIDAD: Caparo, 6 ♂, 4 ♀ (incl. type); (no locality), 4 (?); Chaguaramas, 2 ♂; "Geelet," 1 ♀; Carenage, 1 ♂; Heights of Aripo, 1 ♂; Pointe Gourde, 1 ♂; Princetown, 2 ♂. VENEZUELA: Guiria (Paria Peninsula), 1 ♂; El Pilar (Sucre), 1 ♀; Las Barrancas (Orinoco Delta), 1 ♂; "Orinoko-skin," 1 (?). BRAZIL: Rio Cotínga, Limão, 2 ♀; Rio Surumú, Frechal, 1 ♀. COLOMBIA: Villavicencio, 2 ♀.

P. s. sulphuratus.—FRENCH GUIANA: Cayenne, 3 ♂, 4 ♀, 1 (?); Mana, 1 ♀; Approuague, 2 ♂, 1 ♀. DUTCH GUIANA: near Paramaribo, 3 ♂, 4 ♀, 1 (?); Albina, 1 ♂, 1 ♀. BRITISH GUIANA: Essequibo River, 1 (?); Demerara, 2 (?). BRAZIL: Faro, 7 ♂, 7 ♀; Rio Negro, Igarapé Cacao Pereira, 30 ♂, 8 ♀, 2 (?); Campos Salles, Manáos, 4 ♂, 2 ♀; Muirapinima, 1 ♂, 1 ♀; Yavanari, 2 ♂, 1 ♀; Santa Maria, 2 ♂, 2 ♀; Tabocal, 4 ♂, 3 ♀; Yucabi, 1 ♂, 2 ♀; Santa Isabel, 1 ♂; San Gabriel, 1 ♂; "Brazil," 1 ♂, 1 ♀; Rio Tocantins, Baião, 3 ♂, 2 ♀; Mocajuba, 3 ♂, 2 ♀; Rio Xingú, Porto de Moz, 1 ♂, 4 ♀; Tapará, 3 ♀; Rio Majará, Rereio, 1 ♂; Rio Tapajoz, Aramanay, 5 ♂, 5 ♀; Arumatheua, 1 ♀; Igarapé Brabo, 4 ♂, 4 ♀, 1 (?); Villa Bella Imperatriz, Lago Andirá, 3 ♂, 3 ♀; Boca Rio Andirá, 1 ♂; Santa Clara, 8 ♂; Rio Madeira, Borba, 4 ♂, 1 (?); Igarapé Auará, 1 ♂, 1 ♀; Rosarinho, 6 ♂, 8 ♀, 1 (?); Santo Antonio de Guajará, 2 ♂, 3 ♀; Rio Amazonas, Teffé, 4 ♂, 6 ♀. ECUADOR: Río Suno, above Avila, 1 ♂; Coca, Río Napo, 1 ♂; mouth of Río Curaray, 3 ♂, 4 ♀; mouth of Lagarto Cocha, 1 ♀; "Equateur," 2 (?). PERÚ: Puerto Indiana, 1 ♂, 2 ♀; Iquitos, 1 ♂; Nauta, 1 ♀; Orosa, 1 ♀; mouth of Río Urubamba, 1 ♂, 1 ♀; Santa Rosa, Río Ucayali, 2 ♂, 1 ♀; Sarayacu, 5 ♂, 1 ♀; Astillero, 3 ♂, 1 ♀; Yurimaguas, 1 ♂.

P. s. maximiliani. BRAZIL: State of Bahia, 3 ♂, 2 ♀, 4 (?); Minas Gerais, 5 ♀; Santa Catharina, 5 ♂, 3 ♀, 2 (?); Ceará, 1 ♂, 2 ♀; Paraná, 1 ♀; São Paulo,

1 ♂, 2 ♀; Goyaz, 1 ♂, 2 ♀; Rio de Janeiro, 1 ♂, 3 ♀, 2 (?); Matto Grosso, 4 ♂, 2 ♀; Maranhão, 8 ♂, 2 ♀, 1 (?). BOLIVIA: Trinidad, 1 ♂.

P. s. bolivianus.—BOLIVIA: 11 ♂, 11 ♀. PARAGUAY: 5 ♂, 1 ♀. ARGENTINA: 27 ♂, 11 ♀, 2 (?). BRAZIL: State of Rio Grande do Sul, 10 ♂, 7 ♀, 5 (?).

AMERICAN MUSEUM NOVITATES

Number 964

Published by
THE AMERICAN MUSEUM OF NATURAL HISTORY
New York City

Nov. 19, 1937

EOCENE MOLLUSCA FROM THE SUBATHU GROUP (LUTETIAN) SIMLA HILLS STATE, INDIA

By H. E. VOKES¹

In 1922, during the course of an American Museum Expedition whose principal object was the collection of vertebrate remains from the Siwalik Series, Dr. Barnum Brown made a small collection of mollusca from the Eocene deposits in the Simla Hills State. These are from deposits referred to the Subathu Group and are here described.

In 1853-1854, d'Archiac and Haime described the first fossils from the Subathu region in their 'Description des Animaux Fossiles du Groupe Nummulitique de l'Inde.' They list 49 species, 32 of them being described as new. The fauna is poorly preserved, and the majority of the identifications are based on internal casts, with the result that many are wholly unidentifiable as described and figured in their report. Medlicott (1865, p. 100) lists 17 species of mollusca from his Subathu Group, the identifications being with species described by d'Archiac and Haime or, in 7 cases, to genus only.

These are the only previous reports on the fauna from this area. Cox (1931a) in his report on the molluscan fauna of the Laki and basal Khirthar groups excludes this fauna from his discussion, though referring to these species described from Subathu which have been found in the Laki Collections.

SUBATHU GROUP

The Subathu Group was defined and described by Medlicott (1865, pp. 74-100) who states (p. 74) that the group "exhibits a very considerable diversity of mineral characters" and gives the following general succession:

3. Fine grained, massive sandstones
2. Gritty, lumpy, bright red clays
1. Yellowish-brown silt

Throughout his discussion of these beds, however, he refers to the middle group as being "red and gray, marly nummulitic clays" (pp. 77-78,

¹ Department of Geology and Invertebrate Palaeontology.

etc.). The strata are much contorted, folded and faulted, but the thickness of the group "can scarcely be less than 3,000 feet" (p. 74).

LOCALITIES

Two localities are represented in the collection:

1.—Twenty-one miles northwest of Simla and five miles northwest of Arki. The matrix is a calcareous, yellowish-brown silt, and is referable to the lower beds of the group as defined above.

2.—Twenty-two miles northwest of Simla and six miles northwest of Arki. The matrix is a gray, lumpy clay, somewhat mottled reddish brown and is broken and contorted. The strata at this locality are reported to be vertical.

This clay contains a fauna which is similar to that reported by d'Archiac and Haime from the "Marnes noires" and the middle zone of Medlicott's section is probably to be regarded as that which was referred to by d'Archiac and Haime, despite his assertion (p. 74, footnote) that "I fail to recognize in the Subathu section the rocks spoken of by d'Archiac as Marnes noires and psammite."

AGE OF THE SUBATHU FAUNA

Cox, (1931a), refers the fauna at Subathu to the Lutetian stage, but does not state his reasons for so doing. The material in the present collection does not offer any definite evidence as to the exact correlation of the strata, though there are no forms inconsistent with a Lutetian assignment. Most significant is the presence of the genus *Euphenax*. *E. jamaicensis* (Trechmann), the only species previously described, occurs in the Lutetian of Somaliland and Jamaica, and in the Lower Khirthar, (basal?) Lutetian of India. The genus is represented in our collection by a new species, *E. coxi*. *Involuta daviesi* Cox is also a Lower Khirthar species, but it is represented in our collection by a fragment too poorly preserved to permit certain identification.

DESCRIPTION OF THE SPECIES

A.—Fossils from the locality twenty-one miles northwest of Simla and five miles northwest of Arki, lower zone of the Subathu Group.

EUPHENAX Cox, 1931

GENOTYPE (by original designation).—*Pseudoheligmus* (?) *jamaicensis* Trechmann. Eocene.

Euphenax coxi, new species

Figure 1

HOLOTYPE.—A.M.N.H. No. 24911; length, 30 mm.; height, 37.1 mm.; diameter (both valves), 10 mm.

Shell of moderate size, somewhat *Pteria*-form in outline with a well-marked posterior and a small anterior auriculation. The anterior and posterior margins are slightly convex to almost parallel, the ventral broadly and regularly rounded. Shell very thin, lamellar, the lamellae rising to form a series of radial riblets over the surface, except near the umbo where they have been worn away to expose a series of concentric laminae. The hinge consists of a typical vulsellid ligamental pit and a groove along the dorsal margin to the end of the posterior auriculation. A feebly impressed elongate muscle scar parallels the posterior margin of the shell extending approximately two-thirds the height of the shell from immediately below the posterior ear.

Consideration of the great range of variation shown by Cox (1931, pp. 177-183, Pl. xx, Pl. xxi, figs. 1a, b, 2) to exist in *E. jamaicensis* makes one hesitate to describe a new species of this genus from strata of contemporaneous age. But the differences which separate the present form from the genotype seem to be well beyond the limits of variation indicated for *E. jamaicensis*, and are of specific import. The valves are much less inflated and the shell is equivalved. The presence of a marked posterior dorsal wing appears to be distinctive, though it is not at all times as strongly developed as on the holotype. In the structure of the shell the lamellae do not rise as thin bands equally thick throughout, as indicated by text figure 1, p. 181 of Cox's study, but instead are relatively thick when they debouch from the shell surface and tend to progressively thin toward their outer limits. No cellular structure formed by their fusion above the surface of the shell has been observed. Near the umbo where these outer laminae have been eroded away, the laminated surface of the inner layer of the shell shows no evidence of any development of an ornamentation of fine radial grooves. Internally, the groove extending along the dorsal margin of the valve is distinctive. An apparently similar structure, which seems to be morphologically distinct, is shown by Cox (Pl. i, fig. 1a) extending along the sides of the valve. This, however, is formed between the elongate, radially arranged cells of the outer layer, and the more compact inner layer of the shell. No internal hollow chambers, as indicated by Cox (text figure 2, p. 181), can be observed.

As in *E. jamaicensis* no anterior muscle scar has been noted, and, if as seems most logical, *Euphenax* is a member of the *Vulsellidae*, none is to be expected. However, the extreme posterior dorsal position of the observed scar is a noteworthy and remarkable feature of a monomyarian genus.

OSTREA LINNÉ, 1758

GENOTYPE (by subsequent designation, Children, 1823).—*Ostrea edulis* Linné. Recent.

SUBGENUS *LIOSTREA* DOUVILLÉ, 1904

GENOTYPE (by original designation).—*Liostrea lamellosa* (error pro *O. sublamellosa* Dunker; see Bull. Geol. Soc. Fr., (4) IV, p. 546).

Ostrea (*Liostrea*) cf. *rouaulti* Mallada

Ostrea (*Liostrea*) cf. *rouaulti* Mallada, Cox, 1931a, p. 63, Pl. III, figs. 5, 6, 7, 8.

The variations in shape indicated by the specimens figured by Cox can be closely matched by material in our collections.

CARDITA BRUGUIÈRE, 1792

GENOTYPE (by subsequent designation, Children, 1823).—*Cardita sulcata* Bruguière = *Chama antiquata* Linné. Recent.

Cardita sp. indet.

Two casts of a small, inflated *Cardita* bearing about 20 ribs separated by interspaces of approximately equal width occur in the collections. The ribs appear to have been rounded or flat-topped, and the casts show no evidence of any tripartite characters. The forms resemble *C. subcomplanata* d'Archiac and Haime (1854, p. 252, Pl. XXI, figs. 10, 10a), but appear to be more inflated than that species.

A crushed and fragmentary specimen of a *Cardita* bearing about 17 ribs, markedly tripartite on the posterior and median portions of the valve, is probably to be referred to *C. mutabilis* d'Archiac and Haime (1854, p. 256, Pl. XXI, figs. 3-6). (See: Cox, 1931a, p. 69, Pl. III, figs. 14, 15, 16.) The specimen is, however, too incompletely preserved to permit definite specific determination.

DISCORS DESHAYES, 1858

GENOTYPE (by tautonymy).—*Cardium discors* Lamarck. Eocene.

This is the *Cardium parisiense* d'Orb. of Deshayes (1858, II, p. 569). The only other species included was *C. subdiscors* d'Orb, so that *C. ly-ratum* Sowerby, cited by Fischer (1887, p. 1038) is not available.

Discors simlaensis, new species

Figure 3

HOLOTYPE.—A.M.N.H. No. 24914; length, 27 mm.; height, 31 mm.; diameter (both valves), 19.5 mm.

DESCRIPTION.—Shell of moderate size, inflated, sub-equilateral; umbos moderately small, central; anterior and ventral margins regularly and broadly rounded, posterior ventral margin slightly broken, but sharply rounded, posterior margin broadly convex, dorsal margin short and nearly straight; surface ornamentation characteristic of the genus, the posterior third of the shell surface marked by 23

radial ribs, the anterior 15 of these being moderately well developed and separated by interspaces approximately one-half the width of the ribs; the posterior ribs are finer, the interspaces linear; the anterior portion of the valve is ornamented by distant, low, lamellar riblets which are slightly oblique to concentric and tend to be obsolete on the central area of the shell; hinge not observed.

This may be the form referred by Cox (1931a, p. 84) to *Cardium bunburyi* d'Archiac and Haime (1854, p. 260, Pl. xxxiii, figs. 7, 7a), but, as illustrated, that species is much more inequilateral and differs markedly in outline from our specimen.

ANOPEA MENARD, 1807

GENOTYPE (by subsequent designation, Schmidt, 1818).—*Mya glycimeris* Gmelin. Recent.

Panopea cf. *intermedia* (J. Sowerby)

Figure 2

Panopea cf. *intermedia* (J. Sowerby), Cox, 1931a, p. 85, Pl. iv, figs. 13a, b.

HYPOTYPE.—A.M.N.H. No. 24913; length (incomplete), 33 mm.; height, 19.6 mm.; diameter (both valves), 18.2 mm.

One specimen, slightly smaller, but otherwise identical with that figured by Cox under the above designation, occurs in the collection. It is more complete posteriorly, and the corrugated sculpturing is particularly well developed in this region.

The species described by d'Archiac and Haime (1854, p. 232, Pl. xvi, figs. 2, 2a), as *Panopaea* ? *subelongata* appears to be a venerid, possibly referable to *Macrocallista*.

GOSAVIA STOLICZKA, 1865

GENOTYPE (by original designation).—*Voluta squamosa* Zekeli. Cretaceous, Europe.

Gosavia humberti (d'Archiac and Haime)

Figure 7

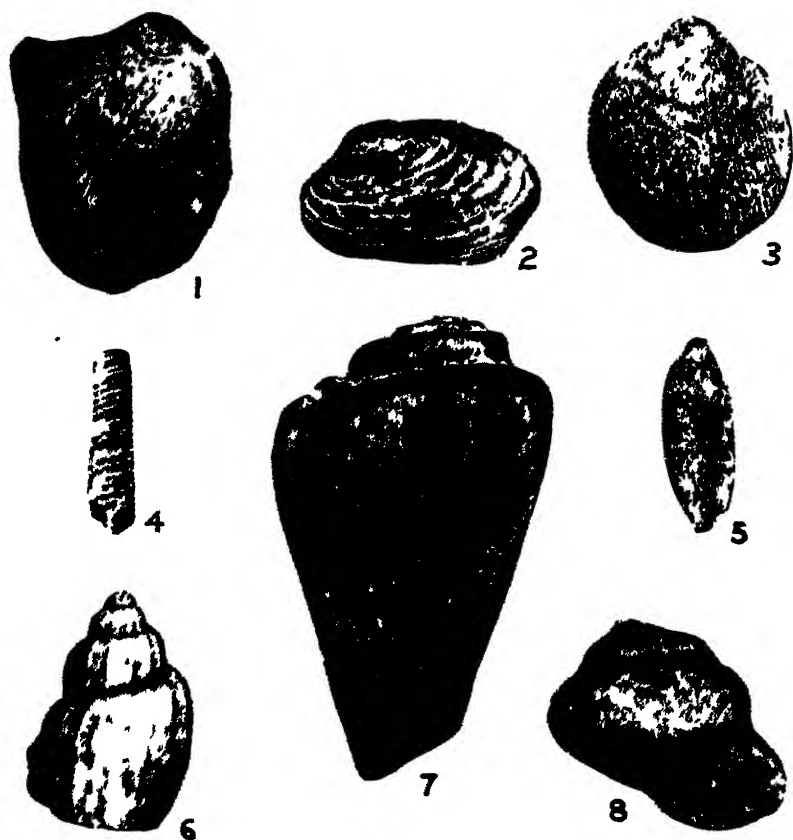
Voluta humberti d'ARCHIAC AND HAIME, 1854, p. 327, Pl. xxxiv, fig. 9.

Gosavia humberti d'Archiac and Haime, STOLICZKA, 1867, p. 73.

Gosavia humberti (d'Archiac and Haime) Cox, 1931a, pp. 57-8, Pl. i, fig. 18.

HYPOTYPE.—A.M.N.H. No. 24909; length, 61.4 mm.; diameter, 39 mm.

Two casts referable to this species are in the collections. In attempting to determine the number of folds on the inner lip (probably five) a small area of shell surface was exposed. This bears distant, low, rounded spiral threads separated by smooth interspaces approximately four times the width of the rib.



- Fig. 1. *Euphenax cori*, n. sp. $\times 1$. Holotype, A.M.N.H. No. 24911.
 Fig. 2. *Panopea* cf. *intermedia* (J. Sowerby). $\times 1$. Hypotype, A.M.N.H. No. 24913.
 Fig. 3. *Discors simlaensis*, n. sp. $\times 1$. Holotype, A.M.N.H. No. 24914.
 Fig. 4. *Seila stracheyi* (d'Archiac and Haime). $\times 2$. Hypotype, A.M.N.H. No. 24916.
 Fig. 5. *Terebellum* sp. $\times 1$. Figured Specimen, A.M.N.H. No. 24915.
 Fig. 6. "*Lyria*" *brouni*, n. sp. $\times 1$. Holotype, A.M.N.H. No. 24910.
 Fig. 7. *Gosavia humberti* (d'Archiac and Haime). $\times 1$. Hypotype, A.M.N.H. No. 24909.
 Fig. 8. "*Turbo*" (?), n. sp. $\times 1$. Figured Specimen, A.M.N.H. No. 24912.

? *Gosavia multidentata* (d'Archiac and Haime)

Voluta multidentata d'ARCHIAC AND HAIME, 1854, p. 326, Pl. XXXII, figs. 1, 1a.

Gosavia multi-dentata d'Archiac and Haime, STOLICZKA, 1867, p. 73.

Gosavia multidentata (d'Archiac and Haime) Cox, 1931a, p. 58.

One specimen apparently representing the genus *Gosavia* and distinguished from *G. humberti* in possessing convex rather than flat sides is questionably referred to *G. multidentata*. The spire is, however, relatively higher than shown in the figures of d'Archiac and Haime (*loc. cit.*). A posterior labial sinus is present. The number of folds on the inner lip cannot be determined.

CONUS LINNÉ, 1758 (*s. lat.*)*Conus* sp.

A crushed and fragmentary specimen in the collections seems to be similar to the form figured by Cox (1931a, Pl. I, fig. 11) as *Conus* sp. indet.

INVOLUTA Cox, 1931

GENOTYPE (by original designation).—*Involuta daviesi* Cox, Eocene, Lower Kirthar group, India.

Cf. *Involuta daviesi* Cox

Involuta daviesi Cox, 1931a, pp. 58–59, Pl. II, figs. 2a, b, c (?), 4.

A fragment of a large individual bearing twelve or thirteen plications on the inner lip of the aperture is tentatively referred to this species. The shell was relatively very thin.

LYRIA GRAY, 1847

GENOTYPE (by original designation).—*Voluta nucleus* Lamarck. Recent.

"Lyria" browni, new species

Figure 6

HOLOTYPE.—A.M.N.H. No. 24910; length (incomplete), 33 mm.; diameter, 22.6 mm.

DESCRIPTION.—The holotype, and only specimen, is incomplete, lacking the nuclear whorls, the anterior portion of the body whorl and the aperture. The shell is of medium size, moderately high spired, of five post-nuclear whorls, which are markedly convex in outline and bear a well-developed sutural shoulder. The suture is impressed. The whorls are ornamented by axial ribs, which are slightly protractive and sinuous, being somewhat continuous down the spire, 14 on the penultimate and ante-penultimate whorls, and 19 on the body whorl.

This species appears to be very similar to that figured by d'Archiac and Haime (1854, p. 323, Pl. XXXI, figs. 19, 20) as "*Voluta jugosa* J. de C. Sowerby ? var. *a.*" Sowerby (1840, p. 329, Pl. XXVI, fig. 25), re-

ferred his species to the Miocene, and Vredenburg (1923, pp. 264, 266) states that it occurs in the Gaj formation (Lower Miocene) of Kachh and Sind. Fedden (1880, p. 208) indicates that the "*Voluta jugosa* C. Sowerby, et var." ranges through the Ranikot, Khirthar, and Nari Groups in Sind. Cox (1931a) does not include the specimen in his study of the material from the Laki Group, which d'Archiac and Haime described.

"*L. browni*" appears to belong to the group of large species of *Lyria* similar to *L. maga* Edwards of the Lutetian-Bartonian of Europe and *L. andersoni* Waring of the Domengine stage of California (see: Clark and Vokes, 1936, Pl. 1, figs. 17, 18), but differs from these species in possessing a larger number of axial ribs. The generic identification of this species is based upon the above resemblance and must be considered as provisional only.

"*Cassidaria*," new species cf. *desori* d'Archiac and Haime

Cf. *Cassidaria desori* D'ARCHIAC AND HAIME, 1854, p. 317, Pl. XXXI, figs. 2, 2a.

A worn fragmentary specimen in the collection somewhat resembles this species, which Fedden (1880, p. 208) reports as from the Ranikot series. Fedden's work contains numerous mistakes (see Cox, 1931a, p. 25, footnote), and none of the subsequent studies of the Ranikot gastropod faunas list this species. Our specimen differs in possessing a slightly less globose body whorl, which has a more sloping shoulder. The ornamentation, which is preserved on the shoulder of the whorl, shows three primary and four intercalated secondary spiral riblets in that area. The surface of the shell over the rest of the whorl is too worn to permit accurate study of the sculpturing.

If the figure of d'Archiac and Haime is to be trusted, the relative absence of callus on the inner lip and columella suggests that their species is probably to be referred to some genus of the *Cassidae* other than *Cassidaria* Lamarck, 1812 (= *Galeodea* Link, 1807). Our specimen shows a slight callus wash near the siphonal fasciole and suggests a possible reference to *Casmaria* H. and A. Adams, 1857.

CAMPANILE BAYLE, IN FISCHER, 1884

GENOTYPE (by subsequent designation, Cossmann, 1889, 'Catalogue Illustré,' Fasc. 4, p. 29).—*Cerithium giganteum* Lamarck. Eocene.

Campanile sp.

One worn fragment, representing approximately two and one-half whorls of a large species of *Campanile*, is present in the collections. The whorls are narrow with a diameter about three times their height, slightly concave in outline, and possess a moderately prominent shoulder immediately below the suture. This shoulder appears to have been ornamented with a strong spiral rib, which may, or may not, have been tuberculate. Immediately below are seven spirals, the first, third, and fifth of which are slightly less than twice the width of the intercalated spirals. The columella was plicated and bore at least two folds.

The specimen has been too greatly crushed to permit accurate determinations of the apical angle, but it appears to have been approximately 23 degrees.

This species appears to possess a larger number of spiral ribs, which are finer and more closely approximate than those of any described species from the Asiatic Eocene deposits. In general, the apical angle seems to be smaller than most described forms, and the spire may have been relatively higher. This may be only an apparent distinction, however, since many species of this genus show a tendency toward an increase in the relative widths of the whorls in the later stages of growth, with a consequently greater apical angle.

AMPULLELLA Cox, 1931

GENOTYPE (by original designation).—*Ampullaria depressa* Lamarck. Eocene.

Ampullella nuttalli Cox

Ampullella nuttalli Cox, 1931a, p. 41, Pl. I, figs. 14a, b.

One specimen, of approximately five whorls, and smaller in size than the holotype, occurs in the collections. The shouldered whorls and the strong siphonal fasciole are distinctive.

"Turbo" (?), new species

Figure 8

FIGURED SPECIMEN.—A.M.N.H. No. 24912; length (incomplete), 27.5 mm.; diameter, 34 mm.

One cast, of three whorls, lacking the apical portion of the shell, is totally unlike any form reported from the Asiatic Eocene, insofar as I am able to discover. The spire is elevated, the whorls broadly rounded and the suture appears to have been linear. The shell was evidently thin, and was imperforate. The aperture is subtrigonal in section, but the outer lip is broken away and growth lines are not visible, so that it is impossible to determine if it was angulate to the periphery.

The systematic position of this form is wholly conjectural. It is provisionally referred to the genus *Turbo* (s. lat.) because of the relatively high spire and the imperforate base. The thin shell, however, does not tend to confirm this assignment. It may prove to be related to *Turbo d'archiardi* Vinassa de Regny (1895, p. 36, Pl. II, fig. 7) from the Alpine Eocene, referred by Cossmann (1918, XI, p. 115, Pl. III, fig. 12, and Pl. X, fig. 45) to the genus *Sarmatius* Gray, 1840, emended (correctly *Sarmaticus* Gray, genotype *Turbo samariticus* Linné, Recent), though the aperture in that species is rounded rather than trigonal.

B.—Species from the locality twenty-two miles northwest of Simla and six miles northwest of Arki, middle zone of the Subathu Group.

Cardita mutabilis d'Archiac and Haime

Cardita mutabilis D'ARCHIAC AND HAIME, 1854, p. 256, Pl. XXI, figs. 3, 6.—Cox, 1931a, pp. 69–70, Pl. III, figs. 14, 15, 16.

Cardita depressa D'ARCHIAC AND HAIME, 1854, p. 255, Pl. XXI, figs. 1, 2; not *Cardita depressa* Lamarck, 1819, Hist. Nat. Anim. sans Vert., 1^{re} Edit., VI, p. 23; nor *C. depressa* Münster, 1839.

A number of specimens representing this species are in the collection, and appear to confirm the conclusion of Cox (1931a, p. 70) that the two species described by d'Archiac and Haime from "Subathoo" "represent one and the same variable species." The elongate, nearly equilateral type of the original *C. mutabilis* is the more abundant form in our collections, and is probably to be considered the normal expression of the species.

Cardita, new species (?)

Cardita subcomplanata var. *a.* D'ARCHIAC AND HAIME, 1854, p. 252, Pl. XXI, figs. 11, *a*, *b* (not figs. 10, *a*).

Four specimens in the collection appear to be referable to the form described by d'Archiac and Haime from "Subathoo" as *Cardita subcomplanata* var. *a.* They appear to bear fewer radial ribs, and to be more equilateral than that species, though one specimen attains a comparable size.

Terebellum (BOLTEN) ROEDING, 1798

GENOTYPE (by tautonymy).—*Bulla terebellum* Linné. Recent.

Terebellum sp.

Figure 5

Terebellum fusiforme LAMARCK ?, D'ARCHIAC AND HAIME, 1854, p. 335, Pl. XXXII, fig. 23.

FIGURED SPECIMEN.—A.M.N.H. No. 24915; length, 26 mm.; diameter, 9.6 mm.

A single specimen of this genus is noted. It agrees with the form figured by d'Archiac and Haime as *T. fusiforme* Lam. ?, but differs from the Paris Basin species in having a more convex outline, and in being relatively wider in proportion to the length of the shell. The spire is higher and the whorls appear to have been slightly shouldered.

SEILA A. ADAMS, 1861

GENOTYPE (by subsequent designation, Fischer, 1884).—*Cerithiopsis dextroversa* (Adams and Reeve) (= *Triphoria dextroversa* Adams and Reeve). Recent.

Seila stracheyi (d'Archiac and Haime)

Figure 4

Cerithium stracheyi D'ARCHIAC AND HAIME, 1854, p. 304, Pl. XXIX, figs. 9, 9a. MEDLICOTT, 1864, p. 100.

Seila stracheyi d'Archiac, COSSMANN, 1906, Ess. Paleoconch. Comp., VII, p. 154.

HYPOTYPE.—A.M.N.H. No. 24916; length (incomplete), 12.8 mm.; diameter, 3.7 mm.

This is the most abundantly represented species in the collection. The three primary spiral ribs appear to be present on all post-nuclear whorls. The earliest of these seem to have the anterior rib more strongly developed than the others, and the whorls tend to be slightly keeled.

The outline of the whorls on our specimens is somewhat more convex than indicated in the original figure, and the species superficially resembles, and might be mistaken for, *Turritella hollandi* Cossmann and Pissarro (1909, p. 60, Pl. v, figs. 17–19) from the Ranikot series. That species attains a larger size, and has a somewhat more deeply channeled suture.

The nucleus is not present on any of the specimens, and the reference to the genus *Seila* is based upon its resemblance to the species from the Paris Basin Eocene referred to that genus by Cossmann (*loc. cit.*). He, however, cites *Cerithium trilineatum* Phil. as the type of the genus *Seila*. This species is not available, for Adams states (Ann. and Mag. Nat. Hist., (3) VII, p. 131) that the "section" was "founded on *Triphoria dextroversa* Adams and Reeve and a new species" [*Cerithiopsis* (*Seila*) *cingulata* A. Adams].

Cerithiidae indet.

A fragment, 2.3 mm. in length, consisting of two whorls of a small species of Cerithiidae, is worthy of mention because of the characteristic nature of the sculpturing. Immediately anterior to the suture is a row of strong, slightly elongate nodes born on a weak, low spiral rib. Below

this, and separated by an interspace approximately as wide as the nodes, is another low spiral bearing strong rounded nodes, separated from each other by spaces of equal width. These nodes are slightly offset to the right in relation to the upper row. The interspace between the two rows is marked by a single simple, spiral riblet. The area of the shell from this second row of nodes to the next suture line is divided into equal parts by three primary spirals, the upper two of which are strongly granulate, but not definitely noded. The posterior spiral is simple.

Cf. *Cepatia cepacea* Lamarck

A single, very immature specimen of a naticoid gastropod resembles similarly immature specimens of the above species from the Eocene of the Paris Basin.

BIBLIOGRAPHY

- ARCHIAC, A. D', AND HAIME, J. 1853-1854. 'Description des Animaux Fossiles du Groupe Nummulitique de l'Inde.' Paris.
- CLARK, B. L., AND VOKES, H. E. 1936. 'Summary of Marine Eocene Sequence of Western North America. Bull. Geol. Soc. America, XLVII, pp. 851-878, Pls. I, II.
- COSSMANN, M. 1895-1925. 'Essais de Paleconchologie Comparee.' 13 vols., Paris.
- COSSMANN, M., AND PISSARRO, G. 1909. 'The Mollusca of the Ranikot Series. Part I. Cephalopoda and Gastropoda.' Pal. Indica, (N. Ser.) III, Mem. No. 1.
- COX, L. R. 1931. 'New Lamellibranch Genera from the Tethyan Eocene.' Proc. Malac. Soc. London, XIX, pp. 177-187, Pls. xx-xxi.
- 1931a. 'A Contribution to the Molluscan Fauna of the Laki and Basal Khirthar Groups of the Indian Eocene.' Trans. Roy. Soc. Edinburgh, LVII, pt. 1, No. 2, pp. 25-92, Pls. i-iv.
- DESHAYES, G. P. 1856-1866. 'Description des Animaux sans Vertebres decouverts dans le Bassin de Paris,' 3 vols., Paris.
- FEDDEN, F. 1880. 'On the Distribution of the Fossils Described by Messrs. d'Archiac and Haime in the Different Tertiary and Infra-tertiary Groups of Sind.' Mem. Geol. Surv. India, XVII, pp. 197-210.
- FISCHER, P. 1880-1887. 'Manuel de Conchyliologie,' Paris.
- MEDLICOTT, H. B. 1864. 'On the Geologic Structure and Relations of the Southern Portion of the Himalayan Range between the Rivers Ganges and Ravee.' Mem. Geol. Surv. India, III, pt. 2.
- SOWERBY, J. DE C. 1840. (Description of the fossils) in Grant, C. W., 'Memoir to Illustrate a Geological Map of Cutch.' Trans. Geol. Soc., (2) V, explan. of Pls. xx-xxvi.
- STOLICZKA, F. 1867-1868. 'Cretaceous Fauna of Southern India, XI, Gastropoda.' Pal. Indica, Ser. 5.
- VINASSA DE REGNY, E. P. 1896-1898. 'Synopsis dei Molluschi terziari delle Alpi Venete.' Pal. Italica, I-III.

- VREDENBURG, E. 1923. 'Indian Tertiary Gastropoda, IV: Olividae, Harpidae, Marginellidae, Volutidae, and Mitridae, with Comparative Diagnoses of New Species.' Rec. Geol. Surv. India, LIV, pp. 243-276, Pls. xiv-xvi.

AMERICAN MUSEUM NOVITATES

Number 965

Published by
THE AMERICAN MUSEUM OF NATURAL HISTORY
New York City

Nov. 29, 1937

AN ANCIENT EUSUCHIAN CROCODILE FROM PATAGONIA¹

BY GEORGE GAYLORD SIMPSON

Much work has recently been done on South American Crocodilia, recent and fossil, and their relationships and history are proving to have unusual interest both in themselves and in relation to the general faunal history of South America. This is particularly striking as regards the Cretaceous and Tertiary forms (see, among others, the papers by Rusconi, by Patterson, and by me cited in the references at the end of this paper). In 1931, the First Scarritt Expedition collected an unusual specimen which was turned over to Dr. Mook for study some years ago. His other duties and researches have so far made it impossible for him to identify or publish this specimen. Since a record of the specimen is an immediate necessity for South American studies being carried on by several different students and since I have in hand work on related animals and general problems, Dr. Mook has kindly turned this specimen back to me for preliminary study. The present paper carries this study only as far as necessary for these general purposes and it is hoped that Dr. Mook will later be able to give a more detailed account of the whole skeleton.

TAXONOMY

ORDER CROCODILIA

SUBORDER EUSUCHIA

Family Crocodylidae

Subfamily Leidyosuchinae

NECROSUCHUS,² NEW GENUS

TYPE.—*Necrosuchus ionensis*, new species.

DISTRIBUTION.—Salamanca Formation, Patagonia.

DIAGNOSIS.—Vertebrae strongly procœlous and skeleton generally eusuchian in character. Jaw long brevirostral. Dentary slender, depth exceeding width posterior to the eighth tooth. Mandible pointed anteriorly, narrow across symphysis, and not noticeably expanded at fourth tooth. Symphysis of dentary ending opposite the posterior end of the fourth tooth. Splenial entering symphysis, reaching alveolar

¹ Publications of the Scarritt Expeditions, No. 30.

² *Nεκρὸς*, dead, + *σαύρος*, crocodile—a sufficiently appropriate name, suggested by the fact that when we were collecting it a well-meaning lady asked us if it were dead.



Fig. 1. *Neorosuchus ionensis*. Right dentary of type, Amer. Mus. No. 3219. Internal, superior, and external views. One-half natural size.

border at seventeenth tooth. Sculpture on dentary slight, pits sparse except in symphyseal region. Eighteen teeth in dentary. First two teeth large and subequal, third smaller, and fourth larger. Fifth to tenth alveoli well differentiated as a series of small individual size. From the eleventh to thirteenth the alveoli increase regularly in size, the thirteenth being nearly as large as the fourth, then they decrease more slowly to the last, eighteenth. Crowns of fifth and fifteenth teeth, at least, acutely pointed. with numerous carinae radiating from the tip.

Necrosuchus ionensis,¹ new species

TYPE.—Amer. Mus. No. 3219, right dentary and most of postcranial skeleton. Found by Olegario García Fanjul, First Scarritt Expedition, April 3, 1931.

HORIZON AND LOCALITY.—Summit of the Salamanca Formation, Uppermost Cretaceous or Basal Tertiary, on the Estancia Las Violetas, near Malaspina, Chubut, Argentina.

DIAGNOSIS.—Sole known species of genus as defined above.

OCCURRENCE AND AGE

Necrosuchus occurs at a particularly crucial point in Patagonian stratigraphy. For this reason and because the origins of most South American fossil crocodiles have been very inadequately recorded, its provenience will be given in some detail.

The Estancia las Violetas of Alfonso Menéndez Behety is very near (southeast of) the intersection of the 45th parallel south and the 67th meridian west, about ten kilometers south-southeast of the small settlement of Malaspina and about thirty kilometers west-northwest of the port of Bustamante in Chubut Territory, central Patagonia, Argentina. It is in a cañadón on the east (Atlantic) slope of a high flat-topped ridge connecting the Pampa de Castillo with the Meseta de Montemayor, and is about twenty-two kilometers from the present shore in a straight line to its nearest point, to the southeast.

Immediately below, southeast of, the estancia buildings there begins a great east-facing barranca which hence extends southward for approximately two leagues. The type of *Necrosuchus ionensis* came from the base of this barranca at its northern end. The following section was measured at this point (oldest beds at bottom):

	FEET
a.—Patagonian marine, probably in place but perhaps somewhat slumped	(not measured)
b.—Outcrop covered	10
c.—Poorly exposed white tuff, clay, fine sand and fine conglomerate, often with a basal black clay	ca. 40

¹ Latin, *ion* (in Pliny), violet, *-ensis*, from the locality, Las Violetas.

	FEET
<i>d.</i> —Very irregular platy tuff, white with red and yellow spots...	4
<i>e.</i> —White, soft tuff, the upper foot or so silicified and purplish...	6
<i>f.</i> —Hard tuff, brown and vesicular when weathered.....	6
<i>g.</i> —Soft ash-gray tuff.....	6
<i>h.</i> —Buff to reddish tuff, the upper part hard and weathering vesicular.....	7
<i>i.</i> —Yellowish or gray-green sand, probably volcanic, with some lava pebbles.....	ca.20
<i>j.</i> —Rather massive gray-green to brownish tuffs grading into volcanic sand with pebbles of pumice.....	ca.60
<i>k.</i> —A hard concretionary band weathering brown.....	1
<i>l.</i> —Pale gray tuff with concretions.....	15
<i>m.</i> —Fine sand and gray clay.....	10
<i>n.</i> —Thin-bedded platy gray sandstone.....	15 =
<i>o.</i> —Fine and coarse sand and gravel with innumerable pieces of fossil wood: HORIZON OF <i>Necrosuchus ionensis</i>	15 =
<i>p.</i> —Glauconitic bed with oyster shells.....	(base not exposed)

The upper part of the section includes the base of the marine Patagonian, Basal Miocene, and what is evidently a truncated Río Chico-Casamayor series with a possible facial equivalent of the so-called *argiles fissilaires*. A few scanty mammal bones, not exactly identifiable but surely early Tertiary, were found in bed *c*. No fossils were found in beds *d*–*n*. The upper beds are not pertinent here and need not be further discussed in this paper, although they are of unusual stratigraphic interest.

From its stratigraphic position and from its character in exposures farther south, into which it can be traced almost continuously, the bed *m* of the above section is almost surely the guide horizon called “banco negro” or “banco negro inferior” in the vicinity of Pico Salamanca, although at the exact point where the present section was measured it is not black and is otherwise atypical. Similarly beds *n* and *o* are not green at this spot and are also atypical but seem to correspond with the “banco verde” of the coastal region farther south. The “banco negro” is commonly taken by convention as the base of the supra-Salamanca series. What this series should be called at any particular point is still very doubtful. It may be the base of the Río Chico or there may be, at least in some places, an intercalated series between the Salamanca and the Río Chico of distinct age or facies. The “banco negro” generally seems to be conformable or at most only locally disconformable on the Salamanca. In this section it is apparently conformable.

The "banco verde" is generally taken as the summit of the Salamanca and this seems to be the character of our bed *o* and perhaps also *n*. Bed *p* is certainly part of the true marine Salamanca and although *o* is of quite different facies, it is probably conformable on and part of the same series as *p*. From the general distribution of the Salamanca, this locality is not far from the western limit of that sea. Bed *p* was probably deposited in shallow epicontinental waters, despite the presence of glauconite. Bed *o* seems to represent a beach, lagoon, or estuarine deposit at, or very near, the shore of the Salamanca sea and formed here when the sea was retreating to the eastward, not to return until the much later Patagonian transgression. The abundant wood in this bed, although completely silicified, has in some places, including this locality, exactly the appearance of driftwood piled up under recent shore or estuarine conditions.

If this interpretation is correct, the bed *o*, where *Necrosuchus* was found, may be synchronous with a marine horizon in the Salamanca farther south along the present coast, where the Salamanca sea was deeper and of longer duration, and with terrestrial deposits farther inland, beyond the area of the Salamanca sea, probably included in the summit of the nominal Chubutiano although in this case surely somewhat and perhaps decidedly younger than typical Chubutiano.

Ameghino considered the Salamanca Formation to be of Cenomanian age. Most recent authors (e.g., Feruglio, 1929) call it Senonian. It is impossible to review all the very complex evidence here, but as far as I am able to judge, it appears to set the Senonian as the upper limit of possible age and does not appear to exclude the possibility or even the probability of a lesser age, perhaps Danian or Montian. I suspect that the Salamanca lies almost on the Cretaceous-Tertiary line, as this line is commonly drawn by vertebrate paleontologists (e.g., between Danian and Montian or between Hell Creek and Puerco equivalents). It may be terminal Cretaceous or it may well be early Paleocene. The condition is strikingly similar to that of the Cannonball in North America.

This tentative conclusion was reached before studying *Necrosuchus*. The evidence of this single form, of a conservative group, is of course not conclusive, but it is consistent with this conclusion as to age and it is probably more consistent with it than with any other opinion. *Necrosuchus* is surely a eusuchian and generally modern in type. Its closest ally is probably *Leidyosuchus* in North America, a genus known from Belly River to Torrejon, or roughly Upper Senonian to late Montian or early Thanetian. The known distribution of *Leidyosuchus* thus nearly

corresponds with the limits placed on the possible age of the Salamanca, at the summit of which occurs this close ally of *Leidyosuchus*. There is some reason to believe that *Necrosuchus* in Patagonia would be younger than the earlier appearances of *Leidyosuchus* in North America, a suggestion far from conclusive but carrying some weight in the absence of conflicting evidence.

DESCRIPTIVE NOTES

The skeleton consists of most of the trunk, with articulated vertebrae, ribs, scutes, and fore and hind limbs, with an associated dentary. The dentary is the most characteristic bone preserved and since it proves adequate for positive diagnosis and determination of affinities the present preliminary paper is based almost entirely on this bone. The postcranial elements, not yet completely prepared, have been examined sufficiently to show that they agree with the evidence of the dentary. Although less characteristic than cranial parts, these skeletal remains are nevertheless of much interest and will be described later. They are unusually well preserved; for instance, the partly cartilaginous sternum and sternal ribs are articulated and clearly shown.

The skeleton is that of a thoroughly modernized, eusuchian crocodile, differing in numerous details but in no fundamental features from other known members of this general group.

Most of the important characters of the dentary are given in the generic diagnosis. The splenial is missing, but the surface on the dentary to which it was applied is sharply defined and shows beyond doubt that the splenial did enter the symphysis. There is a foramen in the dentary on the lower rim of the alveolar canal, posterior to the symphysis, probably correlated with the presence of an aperture in the splenial at this point, as in *Leidyosuchus*. The alveolar border is moderately "festooned," falling somewhat between first and fourth teeth, more markedly between fourth and thirteenth, and thereafter straight. The alveoli are all complete, well separated, and about equally spaced throughout. The twelfth and thirteenth teeth are closer than the others, but even their alveoli are not in contact. The fourth alveolus is definitely spaced from either the third or fifth, despite its enlargement.

Although only the fifth and fifteenth teeth have the crowns preserved, analogy with related forms makes it probable that their similarity indicates essential lack of differentiation in form in the whole series. They are sharply pointed, subconical but with curved crowns, with the usual fore-and-aft crests barely indicated but with numerous well-defined,

subequal, radiating carinae. Although tooth form is generally of little value in identifying crocodiles, these do appear to be distinctive from most or all of the known possibly related genera.

TOOTH DIFFERENTIATION

The crocodiles are, in general, homodont animals. It is, however, well known that within this group there may be considerable difference in form between the various teeth of one individual and that even when all the teeth have approximately the same form they may differ markedly in size. Such tooth differentiation is particularly striking in various alligatorids, including the South American caiman-group, and it is also typical of *Leidyosuchus* and *Necrosuchus*. In attempting to classify *Necrosuchus ionensis* largely on the characters of its dentary,¹ it was necessary to analyze this differentiation and to estimate its significance. The methods and results are here given from the point of view of the study of the affinities of this single species, but these results suggest that tooth differentiation among crocodiles is more exactly measurable and more significant than has hitherto appeared and that it will be worth while to employ similar methods more widely in the study of this group.

Tooth differentiation in form is seen in its extreme among Crocodilia in *Allognathosuchus*, with fairly typical crocodilian teeth (but highly differentiated in size) in the front part of the jaw and depressed, crushing teeth (not much differentiated in size) in the posterior part. Although aberrantly strong in this genus, such qualitative differentiation is characteristic of the Alligatoridae and occurs in great or small degree in most genera of that family. It is nearly or quite absent in *Leidyosuchus*, *Necrosuchus*, and in the Crocodilidae generally.

On the other hand, *Leidyosuchus* and *Necrosuchus* have quantitative differentiation almost equal in degree to that of the jacaré-like alligatorids and similar, but not the same, in kind. This pattern of quantitative differentiation is clearly shown in the accompanying graphs (Figs. 2, 3), in which the serial numbers of the teeth are used as abscissas and the anteroposterior diameters of their alveolar mouths as ordinates,

¹ It has been implied that *Eocaiman* Simpson was based on inadequate material, although as a matter of fact it is the best known and most exactly identifiable of all South American Tertiary crocodilians and also by far the most precisely recorded as to horizon and locality. To anticipate the same reproach as to *Necrosuchus*: its dentary alone is a more adequate type than are the types of any South American Tertiary species except that of *Eocaiman caiemensis*; the comparative study here recorded showed that this dentary is very exactly identifiable (were this not true, it would not have been named); this is accompanied by an unusually well-preserved skeleton that supports and extends the evidence of the dentary although detailed study of it proved to be unnecessary for present purposes; and its origin is better known than is that of any other South American fossil crocodile except *Eocaiman*.

with a line joining the points so determined giving a pattern for each single specimen.

The first noteworthy fact is that these patterns are characteristic for the specimens here treated and may be inferred to be so for the species. Each has a distinctive pattern and the obvious resemblances and differences between these patterns correspond in an unexpectedly

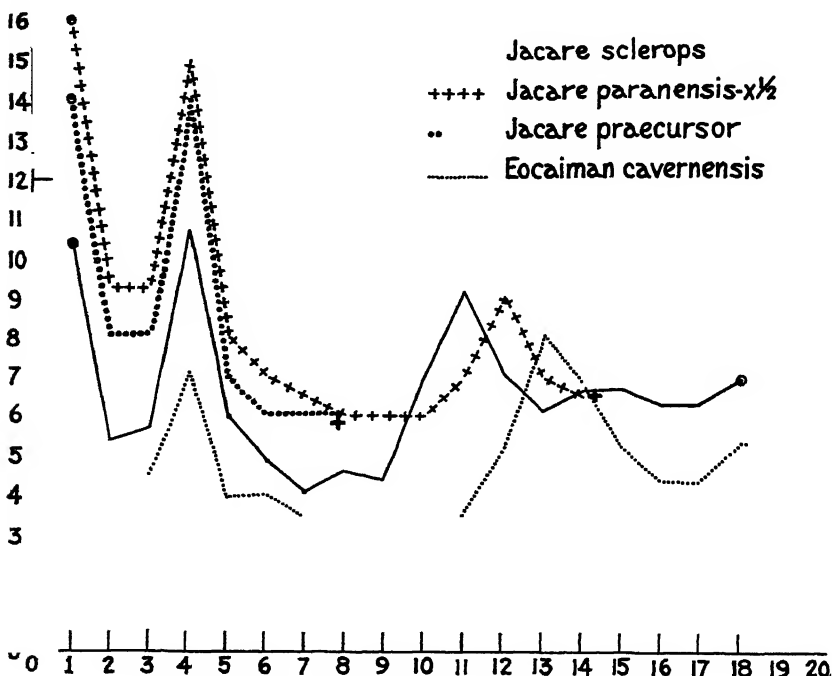


Fig. 2. Mandibular alveolar proportions in jacaré-like crocodilians. The vertical scale represents anteroposterior diameters of alveoli, the horizontal scale the serial numbers of the alveoli. Data for *Jacaré paranensis* and *praecursor* from Rusconi. The measurements for the large species *J. paranensis* have been divided by two to facilitate comparison of the dental pattern with the smaller species.

clear and exact way with the views as to classification and affinities based on other criteria. Thus specimens of the three species already referred to *Jacaré* (by Patterson, who calls the genus *Caiman*) on other grounds obviously give mere variants of the same pattern, which is hence (subject to more extended investigation) inferred to be generic. The type of *Eocaiman cavernensis* differs more from these three species than they do among themselves, but has some basic resemblance to them and

resembles them more than it does *Crocodilus americanus*, for instance, which is in agreement with the conclusion reached on other criteria that it belongs to a distinct genus of the *Jacaré*-group.

In the other series of graphs (Fig. 3), *Necrosuchus ionensis* is shown to give only a slight variant of the *Leidyosuchus sternbergii* pattern, and this sort of pattern is seen to be unlike that of the jacarés and also unlike that of a typical true crocodile, *Crocodilus americanus*.

The most striking mandibular tooth size characters of the *Jacaré*-group (including *Caiman*)¹ seem to be:

- 1.—First and fourth teeth subequal, larger than any others in the jaw with occasionally a single exception.
- 2.—Second and third teeth markedly smaller than first or fourth, usually subequal. (1 and 2 were also true of *Eocaiman cavernensis* although the first two alveoli do not permit exact measurement.)
- 3.—Fourth tooth followed by a series of six to eight smaller teeth, the smallest tooth in the jaw occurring in this series.
- 4.—A single tooth, eleventh to thirteenth in various cases, enlarged, nearly or quite as large as the fourth, with the series becoming abruptly smaller both anterior and posterior to it.
- 5.—Size differentiation as a whole strongly developed.
- 6.—Total number of teeth 18 to 22.

The characters of *Necrosuchus* and *Leidyosuchus* are:

- 1.—First tooth smaller than fourth; fourth the largest in the jaw but first equalled or exceeded by the thirteenth and sometimes by others.

¹ The nomenclature of recent crocodilians is in such a confused state that uniformity can probably never be achieved under the International Rules. It is an obvious case for consideration by the Commission, as has repeatedly been pointed out, but I am not aware that anything has been done about this. In general I have insisted, and still do insist, on strict adherence to the Rules, but the present situation, where their application is doubtful for part and absurd for the rest, is too much for even the most generous attitude toward Rules and Commission. I give below three sets of names applied by three authors to some of the genera and species involved in this paper. Werner attempts to follow the Rules strictly, but even here the use of *Jacaretinga* rather than *Caiman* for the genus usually called *Jacaré* is possibly incorrect under the Rules and he has fallen into at least one definite error. Separation of *Melanosuchus* as a genus is a matter of opinion. *Crocodylus niloticus* is worthy of note as a name applied in this system to a reptile not even belonging to the same family as the crocodile and not occurring within thousands of miles of the Nile. Schmidt follows his own interpretation of the Rules in the use of *Caiman* and common sense in rejecting *Crocodylus* (or *Crocodylus*) and *niloticus* as generic or specific names in the South American Alligatoridae. Mook's nomenclature follows almost universal usage, except that *Jacaretinga* has recently been often used for *Jacaré*.

Werner (1933)

Champs
C. acuta
Jacaretinga
J. crocodilus
Melanosuchus
M. niger
Crocodylus
C. niloticus

Schmidt (1928)

Crocodylus
C. acutus
Caiman
C. sclerops
= *Caiman*
C. niger
Paleosuchus
P. trigonatus

Mook (1921)

Crocodylus
C. americanus
Jacaré
J. sclerops
= *Jacaré*
J. niger
Caiman
C. trigonatus

I will not use Werner's arrangement, unless or until it is confirmed and made official by the Commission. Pending this, I see little reason to follow Schmidt. If one is going to disregard the Rules, it may as well be in favor of the most common and most generally understood usage. Mook's nomenclature represents this usage as well as does any one authoritative arrangement, and I shall follow it.

2.—Second and third teeth slightly unequal, one of them about equal in size to the first.

3.—A series of smaller teeth including among them the smallest in the jaw, following the fourth, as in the *Jacaré*-like genera.

4.—Thirteenth tooth (exact position perhaps variable with more material) enlarged and nearly equal to fourth, approximately as in the *Jacaré*-group, but transition to this tooth somewhat less abrupt anteriorly and markedly less so posteriorly, some of the more posterior teeth being nearly or quite equal to the thirteenth in size.

5.—Size differentiation well developed, but somewhat less than in the *Jacaré*-group.

6.—Total number of teeth in early species 18 or 19, within the *Jacaré*-group range (but number considerably greater in the Paleocene species of *Leidyosuchus*).

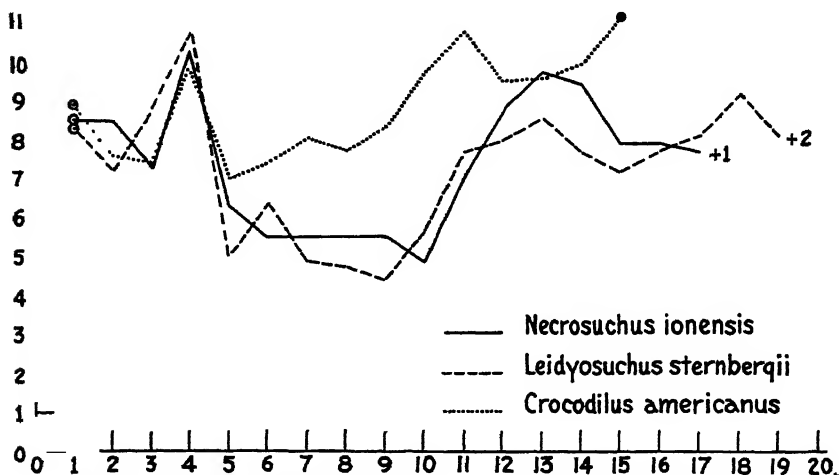


Fig. 3. Mandibular alveolar patterns in *Necrosuchus*, *Leidyosuchus*, and *Crocodilus*. The vertical scale represents anteroposterior diameters of alveoli, the horizontal scale serial numbers of the alveoli.

These differences from the jacarés are, on the whole, points of resemblance to *Crocodilus* and closely allied forms. The corresponding characters of *Crocodilus* appear to be as follows, subject to emendation since I have made no attempt to measure and plot a majority of the species of this protean genus:

1.—First tooth equal to or slightly smaller than fourth; the fourth usually equalled by two or several posterior teeth.

2.—Second and third teeth subequal, usually slightly smaller than first.

3.—Fifth tooth abruptly smaller than fourth and either the smallest in the jaw or about equal to the third; after the fifth the series increases steadily in size to about

the tenth or eleventh and there is no markedly differentiated small series as in the preceding two groups.

4.—Teeth from about the eleventh to the end of the series subequal and nearly or quite equal to the fourth; there is often a tendency for the eleventh tooth to be somewhat the largest.

5.—Size differentiation markedly less than in either of the preceding two groups.

6.—Total number of teeth usually 15.

These graphs show the kind or pattern of size differentiation. It is more difficult to measure and to compare the degree of such differentiation in any adequate way. For this purpose a coefficient of differentiation is tentatively proposed that seems to fill the need for the particular groups here discussed. It is taken as one hundred times the mean deviation divided by the arithmetic mean of the anteroposterior diameters of the first fourteen mandibular alveoli for each individual.¹ The mean deviation for all the teeth is a measure of average size differences, hence of size differentiation, but is not comparable from one species or specimen to another because it depends also on absolute size and on the number of teeth, which are foreign to the character for which a measure is sought. These are eliminated by limiting the alveoli involved to the first fourteen and by dividing by the mean. In the groups of immediate interest here, the size differentiation is largely in the teeth anterior to the fifteenth. The number of rather uniform teeth posterior to the fourteenth varies from one in *Crocodylus* to fourteen in *Leidyosuchus multidentatus*. Obviously if all the teeth were included in the coefficient the figures for these two would not be comparable: that for *Crocodylus* (all species) would be relatively too high and for *Leidyosuchus multidentatus* (and to less extent other species of that genus) relatively too low. Basing the coefficient only on the anterior teeth, where the principal differentiation does occur, is a valid and simple way to avoid this difficulty, although not a perfect solution. Dividing by the mean makes the figure independent of the absolute size and permits valid comparison between individuals and species of different sizes. For instance, *Jacaré paranensis* is clearly a typical *Jacaré* as regards size differentiation, but the mean deviation for the first fourteen alveoli in an individual is 4.7 mm. as compared with only 1.6 mm. for an individual of *Jacaré sclerops*: the figures are not comparable because *J. paranensis* is much larger. Their coefficients are nearly the same.

¹ Calculated by adding the individual measurements, dividing by fourteen (giving the arithmetic mean), subtracting each measurement from this figure (giving the deviations), adding these deviations without regard to their signs, dividing by fourteen (giving mean deviation), dividing by the arithmetic mean, and multiplying by one hundred. This is a short series of easy arithmetical operations and is not as complicated in operation as it may sound in words. No simpler process seems to give a satisfactory result.

Coefficients thus calculated for individuals of some of the species here mentioned are:

<i>Jacaré paranensis</i>	27.7
<i>Jacaré sclerops</i>	24.6
<i>Leidyosuchus sternbergii</i>	22.3
<i>Necrosuchus ionensis</i>	21.5
<i>Crocodylus americanus</i>	11.9

COMPARISONS AND RELATIONSHIPS

Aside from some Jurassic fragments with no bearing on the present case, most of the known South American fossil crocodiles come from five different general regions. There are late Cretaceous and early Tertiary forms from Patagonia, late Cretaceous forms from Uruguay, Upper Cretaceous forms from Bahia and Pernambuco provinces in Brazil, late Miocene or early Pliocene forms from the Paraná, and Upper Tertiary forms from the Rio Purus in Brazil. The Paraná and Purus faunas, imperfectly known in both cases, include jacaré-like and gavial-like species all quite unlike *Necrosuchus*. The Uruguay and the Bahia-Pernambuco crocodiles, mentioned on a later page, are all mesosuchians, as far as known, and still more distant from *Necrosuchus*. In Patagonia *Notosuchus*, *Cynodontosuchus*, and *Microsuchus*, probably from the Cretaceous, are also mesosuchians.

Regarding another Patagonian crocodile, *Symptosuchus*, only the following brief diagnosis has been published (literal translation from Ameghino, 1899, pp. 9-10):

"In the family Goniopholidae there is to be added *Symptosuchus contortidens*, new genus and species, of much greater size than *Notosuchus*. Teeth conical-pointed, slender, somewhat curved, with longitudinal crests, prominent and slightly spiral, which converge toward the end of the crown but without reaching the apex; body armored, with dermal plates decorated with the same sculpture as in the caimans. Cretaceous of Patagonia (Guaranitic Formation)."

The type material evidently included only one or more loose teeth and one or more loose plates, and there is a decided possibility that the genus and species are not recognizable. As far as I know, this material has never been restudied, figured, or more fully described, and it is not at present available to me. The reference to the Goniopholidae (to which the notosuchids were then also referred) would exclude relationship to *Necrosuchus* if confirmed, but it was probably not based on any concrete evidence but only on the fact that only supposed goniopholids,

i.e., notosuchids, were then known from beds of comparable age in Patagonia.

The "longitudinal crests" of the teeth may have been like the carinae of *Necrosuchus*, but nothing is said as to their number and in *Necrosuchus* they are not spiral and do reach the apex. The two genera are probably distinct, as far as the data on *Symptosuchus* give any basis for decision, and everything known of the latter is so vague and uncharacteristic that in any case it is advisable to have a distinctive name for the fully characteristic and well known material of *Necrosuchus*. The age of *Symptosuchus* is unknown. Ameghino's "Guaranitic" included at least eight quite different formations ranging from Cretaceous to Oligocene in age.

Eocaiman (see Simpson, 1933), from the Casamayor, Eocene, was already definitely *Jacaré*-like and a member of this group of South American alligatorids. It differs from *Necrosuchus* in many ways: the tooth differentiation is characteristically different, its teeth do not have strong, subequal, multiple carinae, the posterior teeth have low and laterally compressed crowns,¹ the symphysis is markedly wider and slightly shallower, the splenial does not enter the symphysis, and the dentary as a whole is relatively shorter and stouter. It is unlikely that *Eocaiman* and *Necrosuchus* are closely related within the Eusuchia and almost impossible that *Necrosuchus* is ancestral to *Eocaiman*.

Kuhn (1933) has recently described a few fragments found by von Huene at Punta Peligro.² Although not found in place, these are recorded as from the "Schwarzen Leitschicht," that is, the "Banco Negro Inferior" of local geologists, which immediately overlies the probable equivalent of the bed in which *Necrosuchus* was found. Kuhn identified the specimens as cf. *Holops*, cf. *Bottosaurus*, cf. *Leidyosuchus*, gen. indet. non *Leidyosuchus*, and gen. indet. These rolled, broken, and uncharacteristic fragments, the largest 57 mm. in length, are not determinable beyond the fact that at least one procoelous, eusuchian crocodile is present. Probably some of these specimens belonged to *Necrosuchus*, but detailed comparison would have no particular interest or value. The comparisons with *Holops* and *Bottosaurus* are inconclusive and in part based on somewhat mistaken grounds. They do not need discussion, nor should these genera now be listed in the Patagonian

¹ Contrary to a criticism that has been made, this is a decided point of resemblance to, not of difference from, the genus *Jacaré*.

² This is essentially the type locality of the Salamanca Formation, as the formation is not exposed on Pico Salamanca and is well exposed at Punta Peligro, near the peak for which the formation is named.

fauna. Kuhn's paper was, however, important as giving the first certain record of pre-Casamayor eusuchians in South America.

With the exception of the nearly contemporaneous and not exactly identified or named fragments described by Kuhn, *Necrosuchus* is thus quite unlike any previously known South American crocodilians. It is, however, closely similar to the North American genus *Leidyosuchus* Lambe, 1908, with its species *L. canadensis* Lambe, 1908, from the Belly River of Alberta, *L. sternbergii* Gilmore, 1910, from the Lance (*sensu stricto*) of Wyoming, *L. acutidentatus* Sternberg, 1932, from the Upper Ravenscrag of Alberta, and *L. multidentatus* Mook, 1930, from the Torrejon of New Mexico. It shows the following principal differences from these as a group:

- 1.—Teeth with many carinae; those of *Leidyosuchus* with only two and otherwise nearly smooth.
- 2.—First and second mandibular teeth subequal, third smaller; in *Leidyosuchus canadensis* (type of genus) and *L. sternbergii* the second is smaller than the first and the third larger than either, but in the aberrant *L. multidentatus* the proportions are more as in *Necrosuchus*, while in *L. acutidentatus* the third and fourth teeth are nearly equal.
- 3.—Number of mandibular teeth 18; 18, 21, 20, and 28, respectively, in the four species of *Leidyosuchus*.
- 4.—Symphysis more pointed, less expanded.
- 5.—Fourth tooth pointing more upward, outer contour of dentary not bulging outward here.
- 6.—Splenic reaching alveolar border somewhat more posteriorly (except *L. multidentatus*).
- 7.—Posterior part of dentary higher and more slender.
- 8.—Alveoli all discrete and well spaced; in *Leidyosuchus* the posterior alveoli and sometimes also the third and fourth tend to run together, but this is least noticeable in *L. multidentatus*.

There are also numerous distinctions from any one of the four North American species taken alone. For instance, *L. multidentatus*, although an exception to some of the above distinctions, is quite unlike *Necrosuchus* in the longer symphysis, the weakness of the splenic anteriorly, the very long, rod-like dentary, the remarkably large number of teeth, and other characters in which the genotype and *L. sternbergii* more nearly approach *Necrosuchus*.¹ The type of *L. acutidentatus* is remarkably well preserved, but the published data do not permit as complete comparison with *Necrosuchus ionensis* as for the other species. It seems, however, to differ from the latter at least as much as does *L.*

¹ *L. multidentatus* is so aberrant with respect to the other species that it may not properly belong in *Leidyosuchus*, although doubtless a close relative and to some extent united with them by *L. acutidentatus*.

sternbergii. Sternberg says that the mandible is intermediate between *L. sternbergii* and *L. multidentatus*. In *L. canadensis*, *sternbergii*, and *acutidentatus* the series of large posterior mandibular alveoli may be taken as beginning with the eleventh, in *L. multidentatus* with the twelfth or thirteenth, and in *Necrosuchus ionensis* also with the twelfth or thirteenth.¹

These various distinctions suffice to separate *Necrosuchus* generically either from typical *Leidyosuchus* or from *L. multidentatus*, but all are relatively minor and it seems certain that *Necrosuchus* is a close ally of *Leidyosuchus*. The skeletal characters support this conclusion, as far as they are known in *Leidyosuchus* (of which only a few scattered skeletal parts are known) and I have been able to compare them in *Necrosuchus*.

Leidyosuchus has been classified in the Crocodilidae as opposed to the Alligatoridae, and I tentatively retain this arrangement for *Leidyosuchus* and *Necrosuchus*. A revision or review of the general classification is beyond the scope of this paper, but it cannot but be noticed that this arrangement is not very satisfactory. *Leidyosuchus* and *Necrosuchus* differ from and resemble the Alligatoridae in different ways but about as much as they do the Crocodilidae. Moreover, when all forms are taken into account (note also, for instance, *Diplocynodon*), it seems doubtful whether crocodiles and alligators should really be separated as different families. In any case *Crocodylus* and its close allies, the *Alligator-Jacaré* complex, and *Leidyosuchus* and *Necrosuchus* (possibly also *Allodaposuchus*) evidently represent three different but similar groups of common origin in the Cretaceous. Perhaps it will eventually be most practical to place them as three subfamilies of Crocodilidae.²

CRETACEOUS AND EOCENE SOUTH AMERICAN CROCODILIA

Modifying the usual classification somewhat to accommodate recently discovered forms, the following are the more important crocodilians now known from the late Mesozoic and early Tertiary of South America:

ORDER CROCODILIA

SUBORDER SEBECOSUCHIA

Sebecidae

Sebecus Simpson. *S. icaeorhinus* Simpson, Casamayor Formation, Chubut.

¹ The series begins more abruptly in *L. multidentatus* than in the other species and the doubt is caused by the fact that the intermediate small series seems to have one more tooth on one side than on the other. In *Necrosuchus ionensis* it begins gradually and the doubt is caused by this fact.

² Crocodilia, suborder Sebecosuchia, adopted it in the taxonomy of the present form.

SUBORDER SUCHIA

INFRAORDER MESOSUCHIA

Goniopholidae

Goniopholis Owen. ? *G. hartti* (Marsh),¹ ? *G. derbianus* (Cope),²

Upper Cretaceous, near Bahia and Pernambuco, Brazil.

Notosuchidae

Notosuchus Smith Woodward. *N. terrestris* Smith Woodward, probably late Cretaceous, Neuquén.

Cynodontosuchus Smith Woodward.³ *C. rothi* Smith Woodward, same provenience as *Notosuchus*.

Brasileosaurus v. Huene. *B. pachecoi* v. Huene, Upper Cretaceous (Bauri Formation), Brazil.

Uruguaysuchus Rusconi.⁴ *U. aznarezi* Rusconi, *U. terrai*

Rusconi, Upper Cretaceous, Uruguay.

Mesosuchia *incertae sedis*:

Microsuchus Saez. *M. schilleri* Saez, Upper Cretaceous, Neuquén.

INFRAORDER EUSUCHIA

Crocodylidae

Necrosuchus Simpson. *N. ionensis* Simpson, Salamanca Formation, Chubut.

Alligatoridae

Eocaiman Simpson. *E. cavernensis* Simpson, Casamayor Formation, Chubut.

Crocodylia *incertae sedis*:

Thoracosaurus bahiensis Marsh, cf. *Holops* (fide Kuhn), cf. *Bottosaurus* (fide Kuhn), crocodile "gen. ind. non *Leidyosuchus*" (fide Kuhn), *Symptosuchus contortidens* Ameghino, etc.

The peculiar and specialized nature of *Sebecus* implies a long history and probably relatives will eventually be found elsewhere, but at present it seems to be only very distantly related to any other known reptiles. The Brazilian forms referred doubtfully to *Goniopholis* are not very adequately known, but it is evident that members of this general group are present. This sort of crocodile is widespread in marine and semi-marine Cretaceous beds in the northern hemisphere and it is interesting but not surprising to learn that they also reached South America.

Cynodontosuchus, *Microsuchus*, and *Brasileosaurus* can be set aside as inadequately known or studied and probably related to better known notosuchids. *Notosuchus* and *Uruguaysuchus* are relatively well known

¹ Described by Marsh under *Crocodylus* from teeth and uncharacteristic fragments. Woodward (in Mawson and Woodward, 1907) referred a symphysis and other fragments to this species, on rather insecure grounds, and placed it in *Goniopholis*.

² Described by Cope (1885) as *Hyposaurus derbianus*, based on relatively good material, a lower jaw, and other parts, not figured. *Hyposaurus* is provisionally made a synonym of *Goniopholis* by Mook (1925). The Cretaceous Brazilian forms need revision.

³ It is not quite certain that this poorly known form belongs in this family.

⁴ Probably a synonym of *Brasileosaurus*.

and are evidently allied but well distinguished genera, representing a very peculiar, archaic side branch of the Mesosuchia. They cannot be closely allied to *Goniopholis*, as was at first supposed, and surely they are not ancestral or at all closely related to any of the latter forms known from South America (or elsewhere).¹ These notosuchids have been compared with various other small, brevirostral forms but no intimate relationship has been established. Thus Mook (1934) refers *Libycosuchus* definitely and *Hoplosuchus* doubtfully to the Notosuchidae. Stromer (1914) concluded that the resemblance of *Libycosuchus* to *Notosuchus* is superficial and that the two are not really closely related, and in this I concur, as far as I can judge from the literature. In any case the relationship cannot be close enough to have any decisive bearing on paleogeography or correlation. Among many other facts, it is noteworthy that *Libycosuchus* is at least as old as *Notosuchus* and probably older, yet is distinctly more specialized in numerous characters.

Hoplosuchus was originally described as an aëtosaur (Gilmore, 1926), but von Huene (1933) has given good reasons for considering it a crocodile, parallel or more or less distantly allied to the Atoposauridae. It does suggest a form such as could well have given rise to the Notosuchidae, but this remains only a possibility as long as the detailed structure of *Hoplosuchus* is unknown.

Eocaiman is surely related to *Jacaré*, *Caiman*, and allied late Tertiary and Recent South American forms, carrying the history of this distinctively Neotropical group back into the Eocene in the same region. It is, of course, unlikely that a single Patagonian specimen and species should represent the actual ancestry of the later forms, but this genus does so structurally and no definite character excludes it from the actual ancestry. The only known fact opposing this is that one Paraná species of *Jacaré*, *J. praecursor*, is said by Rusconi (1933) to have the splenial entering the symphysis. Since, however, the splenial very closely approaches the symphysis in the type of *Eocaiman cavernensis*, it is entirely possible that it entered it in other species of the genus, or even in other individuals of the species. The close resemblance of *Eocaiman* to *Allognathosuchus* shows approach to the common stock of the alligators (s. s.) and the jacarés (s. l.). The tooth differentiation is of quite the same sort in *Allognathosuchus* and in the jacaré-group, only in

¹ In his very admirable summary of the fossil Crocodilia, von Huene (1933) denies special relationship between *Notosuchus* and *Uruguaysuchus* and seeks to derive the alligatorids from *Uruguaysuchus*. This is not the place to discuss the question fully, but I have studied it at great length and am convinced that in this one point v. Huene is mistaken. It seems extremely probable that Rusconi was correct in placing *Uruguaysuchus* in the Notosuchidae, and it seems impossible that it should be ancestral to *Eocaiman* or other Tertiary alligatorids.

Allognathosuchus it has gone to an extreme that removes that group from the *Alligator* main-line, but not far.

The different position of the posterior apex of the alveolar diameter graph in *Eocaiman* and in species of *Jacaré* (Fig. 2) is not opposed to close relationship. In *Eocaiman cavernensis*, Eocene, it is on the thirteenth tooth, in *Jacaré praecursor*, Miocene-Pliocene, on the twelfth, and in *J. sclerops*, Recent, on the eleventh in the specimens illustrated. It is, however, both individually and specifically variable even in contemporaneous forms and is often on the twelfth in the recent species. It is easy to frame a reasonable hypothesis adequate to explain this variation and to explain a possible tendency for the apex to shift forward with the passage of time. In the first place, reduction would be most likely to occur in the smallest teeth, which are between this apex and the fourth tooth, and such loss would shift the apex forward. From a broader point of view, there is considerable evidence that a size pattern in a dentition is inherited as a whole and not by the inheritance of an individual size factor for each separate tooth, and this would perhaps be particularly true in a dentition with numerous teeth all of about the same form. In such a case, individual homologies in the teeth would be more or less incidental or nominal and the important character would be the whole pattern as a unit. Slight shifting, compression, or expansion of the pattern with respect to the concrete series of individual teeth might readily occur and would have little bearing on affinities or descent.

The relationship of *Eocaiman* to *Allognathosuchus* is one of many facts tending to indicate common origin of North and South American faunas in the Cretaceous. *Necrosuchus*, with its close approach to *Leidyosuchus*, is an even more striking example of the same sort.

The recent discovery of *Eocaiman* and *Necrosuchus* shows how great is the chance that apparent faunal differences are due in part to lack of discovery.¹ Nevertheless there is little probability that the two faunas will ever be found to be essentially the same. Many North American animals seem never to have reached South America, and similarly there are groups in South America even at the beginning of the Tertiary for which close Holarctic allies or parallels are not known. The suggestion is that a connection existed but that it was to some degree selective, a differential migration route along which passed numerous animals but not integral faunas, and further that the whole South American fauna probably did not enter by this one route and at this one time. This is a

¹ Doubtless true of the North American fauna as well as the South American, despite the fact that much more work has been done in North America.

very broad problem which I hope to discuss at more length elsewhere. At present it suffices to show the tendency of the growing body of evidence derived from the Crocodilia.

REFERENCES

- GILMORE, C. W. 1910. '*Leidyosuchus sternbergii*, a new species of crocodile from the *Ceratops* beds of Wyoming.' Proc. U. S. Nat. Mus., XXXVIII, pp. 408-502.
1926. 'A new aëtosaurian reptile from the Morrison Formation of Utah.' Ann. Carnegie Mus., XVI, pp. 325-348. [*Hoplosuchus kayi*.]
- VON HUENE, F. 1931. 'Verschiedene mesozoische Wirbeltierreste aus Sudamerika.' Neues Jahrb. Min. etc., Beil.-Bd. LXVI, Abt. B, pp. 181-198. [*Brasileosaurus pachecoi*, described as a coelurosaur but later (v. Huene, 1933), said to be a crocodile possibly of the same genus as *Uruguaysuchus aznarezi*; other crocodiles are mentioned but they are not identifiable and are not specially noticed in the present paper.]
1933. 'Ein Versuch zur Stammesgeschichte der Krokodile.' Centralbl. Min. etc., Jahrg. 1933, Abt. B, No. 11, pp. 577-585.
- KUHN, O. 1933. 'Über Reste procoeler Crocodilier aus der obersten Kreide von Patagonien.' Pal. Zeits., XV, pp. 81-92.
- LAMBE, L. M. 1908. 'On a new crocodilian genus and species from the Judith River Formation of Alberta.' Trans Roy. Soc. Canada, Ser. 3, I, pp. 219-244. [*Leidyosuchus canadensis*.]
- MOOK, C. C. 1921. 'Skull characters of recent Crocodilia with notes on the affinities of the recent genera.' Bull. Amer. Mus. Nat. Hist., XLIV, pp. 123-268.
1925. 'A revision of the Mesozoic Crocodilia of North America.' Bull. Amer. Mus. Nat. Hist., LI, pp. 319-432.
1930. 'A new species of crocodilian from the Torrejon beds.' Amer. Mus. Novitates, No. 447, pp. 1-11. [*Leidyosuchus multidentatus*.]
1934. 'The evolution and classification of the Crocodilia.' Journ. Geol., XLII, pp. 295-304.
- NOPCSA, F. 1928. 'Palaeontological notes on reptiles. VII. On the classification of the Crocodilia.' Geol. Hungarica, ser. Pal., I, Fasc. 1, pp. 75-84.
- PATTERSON, B. 1936. '*Caiman latirostris* from the Pleistocene of Argentina, and a summary of South American Cenozoic Crocodilia.' Herpetologica, I, pp. 43-54.
- RUSCONI, C. 1933a.¹ 'Sobre reptiles cretáceos del Uruguay (*Uruguaysuchus aznarezi*, n.g. n.sp.) y sus relaciones con los notosúquidos de Patagonia.' Inst. Geol. Montevideo, Bol. No. 19, pp. 1-64. [Also *U. terrai*.]
- 1933b. 'Observaciones críticas sobre reptiles terciarios de Paraná (familia

¹ Copies bear the printed date 1933 and separates were distributed in 1934. Rusconi (pers. com.) states that the paper was issued in September, 1932. No question of priority is involved and I cite by the printed date to facilitate finding the paper.

- Alligatoridae).' Rev. Univ. Nac. Córdoba, XX, pp. 1-52. [This and the preceding paper cited from separates.]
- DE SAEZ, M. D. 1928. 'Un nuevo goniofólide argentino.' An. Soc. Ci. Argentina, CVI, pp. 287-290. [*Microsuchus schilleri*.]
- SCHMIDT, K. P. 1928. 'Notes on South American caimans.' Field Mus. Nat. Hist., Pub. 252; Zool. Ser., XII, No. 17, pp. 205-231.
- SIMPSON, G. G. 1933. 'A new crocodilian from the *Notostylops* beds of Patagonia.' Amer. Mus. Novitates, No. 623, pp. 1-9. [*Eocaiman cavernensis*.]
1937. 'New reptiles from the Eocene of South America.' Amer. Mus. Novitates, No. 927, pp. 1-3. [*Sebecus icaeorhinus*.]
- STERNBERG, C. M. 1932a. 'A new fossil crocodile from Saskatchewan.' Canadian Field Nat., XLVI, pp. 128-133. [*Leidyosuchus acutidentatus*.]
- 1932b. 'The skull of *Leidyosuchus canadensis* Lambe.' Amer. Midland Nat., XIII, pp. 157-169.
- STROMER, E. 1914. 'Ergebnisse der Forschungsreisen Prof. E. Stromers in den Wüsten Ägyptens. II. Wirbeltier - Reste der Baharije - Stufe (unterstes Cenoman). 1. Einleitung und 2. *Libycosuchus*.' Abh. K. Bayer. Akad. Wiss., Math.-phys. Klasse, XXVII Bd., 3 Abh., pp. 1-16.
- WERNER, F. 1933. 'Reptilia Loricata.' Das Tierreich, Preus. Akad. Wiss. Berlin, 62 Lief., pp. i-xiv, 1-40.
- WOODWARD, A. S. 1896. 'On two Mesozoic crocodilians, *Notosuchus* (genus novum) and *Cynodontosuchus* (genus novum), from the red sandstones of the Territory of Neuquen (Argentine Republic). An. Mus. La Plata, Pal. Argentina, IV, pp. 1-20.

AMERICAN MUSEUM NOVITATES

Number 966

Published by
THE AMERICAN MUSEUM OF NATURAL HISTORY
New York City

Dec. 4, 1937

THE BIRDS OF THE SAGE WEST CHINA EXPEDITION

By HUGH BIRCKHEAD

The Sage West China Expedition had as its main object the collecting of mammals of eastern Szetchuan. Notwithstanding the fact that the collection of birds was only a secondary object of the expedition, a fine collection of 426 specimens was obtained from a region which was particularly poorly represented in The American Museum of Natural History. This collection has filled many gaps in our material, and the study of these birds has helped to clear up a number of doubtful points concerning the taxonomy of the birds of western China.

The staff of the expedition consisted of Mr. and Mrs. Dean Sage, Jr., William G. Sheldon, and T. Donald Carter.

The collecting stations were as follows:

Wenchwan, W. Szetchuan, September 15, 1934; 1 bird collected.

The Chen Liang Shan Range, 30 mi. W. of Wenchwan, 9500 feet altitude, September 26–October 12; 18 birds collected.

Tsao Po, 18 mi. S. W. of Wenchwan, 5000 feet altitude, October 12, 14, 16–November 1, 4, and December 9, 11; 128 birds collected.

Near Tsao Po, 8700 feet altitude, October 20; 2 birds collected.

La Pei, Cheng Gou Creek, 20 mi. W. of Wenchwan, 6000 feet altitude, October 21; 2 birds collected.

Cheng Wei, Cheng Gou Creek, 25 mi. W. of Wenchwan, 6000 feet altitude, October 23–November 24, and December 5, 6; 133 birds collected.

Cheng Gou Forks, 30 mi. W. of Wenchwan, November 26–December 4; 66 birds collected.

Cheng Gou, 25 mi. W. of Wenchwan, December 6, 8; 19 birds collected.

Cheng Gou, 7000 feet altitude, December 9, 10; 12 birds collected.

Mao Mo Gou, 30 mi. W. of Wenchwan, 8600 feet altitude, November 19, 21, 23, and 25; 7 birds collected.

Chengt'u, December 23–25; 32 birds collected.

Min River, 40 mi. S. of Kiating, January 9, 14, 1935; 5 birds collected.

Near Nankin, February 10, 1935; 1 bird collected.

In the working out of the collection I was greatly assisted by Dr. Ernst Mayr, to whom I am much indebted for his advice and in joint authorship with whom some of the new subspecies are described. The curators of the Museums in Cambridge, Philadelphia, Washington, and Chicago sent us considerable material for comparison, and Dr. Boris Stegmann gave us valuable information on the *Ithaginis sinensis* group.

Thanks are also due to the Chinese Government, by whose coöperation the expedition was made possible.

The treatment of this collection differs somewhat from that in similar papers. I have not listed every one of the 86 forms that were obtained by the expedition, but have restricted my remarks to those species in which the study of the material has contributed new facts concerning the distribution or geographical variation of the birds of western China.

Falco tinnunculus interstinctus McClelland

1 ad. ♀, Oct. 24, Tsao Po, and 1 ad. ♂ (no date), Cheng Gou. These two birds are definitely *Falco tinnunculus interstinctus*.

Falco tinnunculus stegmanni (Portenko)

1 ad. ♂, Oct. 25, Tsao Po. This Central Asiatic race extends apparently all the way from Turkestan to Mongolia through the dry highlands. In addition to the Carter-Sage specimen, I have examined winter birds from Yunnan, as well as a series from Turkestan.

Tetraophasis obscurus Verreaux

One specimen (ad. ♂) of this rare species was obtained at Tsao Po (5000 feet) on November 4, 1934.

Ithaginis cruentus
sinensis group

Only three forms (*sinensis*, *berezowskii*, and *michaelis*) have thus far been recognized in the *sinensis* group of *Ithaginis cruentus*. An examination of our material reveals that there are two additional undescribed forms.

These five forms can be divided quite naturally in two groups: one has the brown of the wing-coverts frequently mixed with red, and not or only little washed with green (Szetchuan and *berezowskii*); the other has the rufous brown of the wing-coverts strongly washed with green (*michaelis*, north Kansu), while typical *sinensis* occupies an intermediate position. The two groups also differ in some other characters, with *sinensis* again being more or less intermediate between the *berezowskii* group and the *michaelis* group.

Ithaginis cruentus annae Mayr and Birkhead, new subspecies

TYPE.—No. 450995, Amer. Mus. Nat. Hist.; ♀ ad.; Cheng Gou Forks (7600 ft.), 30 miles west of Wenchwan, Szetchuan; Dec. 4, 1934; Sage-Carter coll.

MALE.—Similar to *I. c. berezowskii* Bianchi, but more richly colored and averaging smaller, the black bordering the white shaft-streaks of the back narrower; the feathers of the neck paler gray, the brown of upper wing-coverts and inner secondaries darker, the white stripes on ear-coverts and head-tuft broader, the crown paler gray and more distinctly streaked with white, and the under tail-coverts warmer, more orange-red.

FEMALE.—Similar to that of *berezowskii*, but considerably darker and more earth brown, less tawny; black vermiculation of upper parts more pronounced; rump and tail with a distinct gray wash; upper throat, sides of head, and crest of a purer gray, not brownish.

Wing, ♂ ad., 193, 197, 199, 200, ♀, 184, 191; tail, ♂ ad., 167, 170, 170, 178, ♀, 142, 146; tarsus, 62-63.

1 ad. ♂, Oct. 3, 2 ad. ♂, Oct. 12, and 1 ad. ♀, Oct. 8, Chen Liang Shan Range; 4 ad. ♂, Oct. 30, 2 ad. ♂, Nov. 1, 1 ad. ♂, Nov. 4, 3 ad. ♀, Nov. 13, 16, and 26, 2 ad. ♀, Nov. 29, and 2 ad. ♀, Nov. 4, Tsao Po; 3 ad. ♂, Nov. 1, 3 ad. ♂, Nov. 3, 2 ad. ♂, Nov. 5, 3 ad. ♂, Nov. 10, 16, and 20, 2 ad. ♀, Nov. 3, and 1 ad. ♀, Nov. 4, Cheng Wei, Cheng Gou Creek; 1 ad. ♀, Dec. 23, Cheng Gou Forks; and 1 ad. ♂, Dec. 9, Cheng Gou.

RANGE.—Northwest Szetchuan.

REMARKS.—The series of *annae* is quite variable; one bird has the greater upper wing-coverts heavily washed with red, two others just slightly so, and two show no red at all; the ear-tufts are extensively streaked with white in some birds, in others, they are pure black; variable are also the amount of greenish wash on the white shaft-streaks of the lower back, the amount of red on forehead and chin, and the width of the white streaks of the upper parts.

Three males collected by Weigold at Sungpan, northeast Szetchuan, are intermediate between *annae* and *berezowskii*, but nearer to *annae*. The females, however, collected at the same locality, are very much closer to *berezowskii*. It is probably best to include this intermediate population with *berezowskii*.

The type locality of *I. s. berezowskii* Bianchi is the southernmost part of Kansu, in the vicinity of the villages Dju-djuau and Satani, in the Siku district. Since we have no material from this district, we sent some specimens of *annae* to Dr. B. Stegmann (Leningrad) who very kindly made the following comments (April 10, 1937): "Your specimens from Szetchuan belong undoubtedly to a new form. They are similar to *berezowskii*, but generally darker, the brown coloration of the innermost secondaries deeper, and the markings ("Zeichnung") more pronounced. The only female of *berezowskii* is considerably lighter and

more reddish brown than your specimen; throat and chin are less gray, more fawn-colored. One should not forget, of course, that your specimens are in fresh plumage and recently collected, while our specimens are mostly summer birds and have been collected quite some time ago. The difference is, however, so great that it cannot be explained by wear and by post-mortem changes in the collection." He very kindly sent us an adult male from the type locality which fully agreed with the comments in his letter.

It gives us great pleasure to name this new subspecies in honor of Mrs. Anne Sage, who has done so much for the success of this expedition, and who has herself collected and prepared a large proportion of the bird-skins.

Ithaginis cruentus berezowskii Bianchi

Ithaginis sinensis berezowskii BIANCHI, 1903, *Annuaire Mus. Zool., St. Petersburg*, VIII, pp. 5-6.—Southern Kansu, near the villages of Dju-djuau and Satani in the Si-ku (or Si-gou) district.

Differs from *annae* as described above; characterized (in comparison with the other races) by the small size, rather dark coloration of the males, by the red wash of chin and cheeks, by the brown secondaries and upper wing-coverts which are washed with red, not with green, and by the warmer red of under tail-coverts and edges of tail-feathers.

Adult male: wing, 202; tail, 156; tarsus, 61.

RANGE.—South Kansu and adjacent part of north Szetchuan (Sungpan).

Sungpan birds, which are not quite typical, measure as follows: wing, ♂ ad., 196, 205, 207, ♀ 193, 198, 202, 204; tail, ♂ 157, ♀ 135, 140, 152, 155; tarsus, ♂ 63, 63, 65, ♀ 60, 61, 63, 63.

Ithaginis cruentus sinensis David

The remaining forms of the *sinensis* group have been much confused, because none of the previous authors had all the forms before him and wrong names were applied to certain populations by all of them. Bianchi (*loc. cit.*) assumed erroneously that a series of birds from northern Kansu was identical with typical *sinensis* (described from southern Shensi) which he had not seen, while in fact it was an undescribed form (see below). Hartert (*Vögel pal. Fauna*) accepted Bianchi's use of *sinensis* for the north Kansu birds, but recognized that south Shensi birds were quite different. Not having seen *berezowskii*, he called them *berezowskii*, although they were actually the typical *sinensis*. Recognizing the vast difference between Shensi and Szetchuan "*berezowskii*,"

we sent a series of each to Dr. Stegmann for comparison with the actual *berezowskii*. He informed us, as we had suspected, that neither of them was *berezowskii*, and advised a study of the name of *sinensis* to settle whether it applied to the Tsinling Mt. (Shensi) or to the north Kansu population. We are very grateful to Dr. B. Stegmann for his detailed comments on the various forms.

Ithaginis sinensis was discovered by David "in the highest mountains of southern Shensi." He found it "in the center of the Tsinling Mts. at an altitude of 3500 m.," between Lao-ling and Honan. These two localities are apparently at the northern slope of the Tsinling Mts., while Mt. Tai-pai-shan, where Allan Owston's collectors took a large series for Lord Rothschild, is on the southern slope. There is no reason to believe that the birds from the north and south slope should be different in this region where they are a high mountain species, particularly since all these localities are apparently fairly close together. Furthermore, the characters shown on plate 114 of David and Oustalet, 'Oiseaux de la Chine,' Vol. II, as well as given in the detailed description (*op. cit.*, Vol. I, p. 402) apply excellently to our Tsinling Mt. series, but not to the northern Kansu birds.

The subsequent description of *sinensis* is based on a series of over 50 specimens from Tai-pai-shan, Tsinling Mts.

Ithaginis cruentus sinensis David

Ithaginis sinensis DAVID, 1873, Ann. Sci. Nat., Zool., (5) XVIII, Art. 5, p. 1.—Tsinling Mts., Shensi.

MALE.—A very dark form; the white shaft-streaks on the back are very narrow and the black bordering it, very wide; white shaft-streaks on the rump broader and frequently tinged greenish; very little or no red on forehead, cheeks, and chin; crown, nape, and sides of neck dark gray; wing (= innermost secondaries and greater upper wing-coverts) rufous brown, not at all mixed with red and only faintly tinged with green; the whitish shaft-streaks of the greater upper wing-coverts broadly edged with black, which makes them very conspicuous; most of the green feathers of breast and flanks with narrow or broad black edges; under tail-coverts and edges of tail-feathers warm red, but not as scarlet (not as mixed with orange), as *berezowskii* or *annae*; size rather small.

FEMALE.—Lighter and more rufous brown than female of *annae*; quite pale on the under parts; differs from north Kansu birds by the rufous, not grayish, coloration of the upper parts and by the darker color of the under parts.

MEASUREMENTS.—Adult males (fresh plumage): wing, 203, 204, 206, 207, 207, 208, 210; tail, 162, 167, 168, 172, 172, 177, 177; tarsus, 59, 60, 61, 63, 63, 64, 65. Females, wing, 191, 194, 195; tail, 140, 142, 142; tarsus, 58, 59, 60.

RANGE.—Tsinling Mts., Shensi, southern and northern slope.

Ithaginis cruentus beicki Mayr and Birkhead, new subspecies

TYPE.—No. 446867, Amer. Mus. Nat. Hist.; ♂ ad.; Tschau-tou, Sining district, north Kansu; February 15, 1927; W. Beick.

MALE.—Light and large; general coloration of upper parts similar to *berezowskii*; white shaft-streaks on back average slightly narrower, but black borders are the same width; shaft-streaks on rump usually white; usually no red on forehead, cheeks, and chin; crown and nape light gray; brown of wing without red, but conspicuously washed with green; shaft-streaks on greater upper wing-coverts greenish or brownish green narrowly bordered with black; green feathers of breast and flanks usually without black margins; under tail-coverts and edges of tail-feathers a cold pinkish red with a slight purplish tinge.

FEMALE.—Large and pale; crest and sides of face gray; back, rump, and tail with a strong grayish tinge.

MEASUREMENTS.—Ad. males: wing, 204, 208, 209, 212, 214, 216, 216, 217, 217, 218, 219, 220, 225; tail, 170, 174, 178, 181, 184, 185, 187, 188, 191, 192, 194, 196, 196; tarsus, 61–66. Ad. females: wing, 192–211 (201.6); tail, 155–169 (161.0); tarsus, 55–63 (60.0).

RANGE.—Northern Kansu, Chortentan, Tetung River, (Przewalski, Kozlow), South Tetung Mts., Tsan-fou at the Tetung River (Beick).

A male collected by Przewalski in February (apparently at Chortentan) and a male collected by Beick at Honanpa (see map, Journ. f. Ornith., 1937, p. 404) have the rump slightly washed with green and indicate a tendency toward *michaelis*.

Ithaginis cruentus michaelis Bianchi

Ithaginis sinensis michaelis BIANCHI, 1903, Annuaire Mus. Zool., St. Petersburg, VIII, pp. 3–4.—Northern slope of Nan-Shan Mts.

MALE.—Similar to *beicki*, but paler gray; shaft-streaks of middle and lower back, rump, and upper tail-coverts washed with green; less red on the edges of the tail-feathers.

FEMALE.—Unknown to us.

SIZE.—Approximately as in *beicki*.

RANGE.—Chycho River, northern slope of the Nan-Shan Mts.; Baboche, Edzingol River; Mt. Ngin-sin-shan, N. Kokonor Barrier Range.

Pucrasia macrolopha ruficollis David and Oustalet

2 ad. ♂ and 2 ad. ♀, Oct. 15, Chen Liang Shan Range (9500 ft.); 2 ad. ♂, Oct. 20, 2 ad. ♂, Oct. 25 and 26, 3 ad. ♂, Oct. 29, 2 ad. ♂, Oct. 30 and Nov. 1, 1 ad. ♀, Oct. 14, and 2 ad. ♀, Oct. 25, Tsao Po (5000 ft.); and 2 ad. ♂, Nov. 3 and 5, 1 ad. ♀, Nov. 1, and 2 ad. ♀, Nov. 7, Cheng Wei, Cheng Gou Creek (6000 ft.).

I have seen no topotypical material from Shensi, but the Sage specimens agree very well with the description. Besides the characters

given by Hartert (V. p. F., III, p. 1973), there are the following additional ones, as compared with *xanthospila* from Chili. under tail-coverts and stripes of the tail mostly black or blackish, not rufous; under parts darker rufous, less yellowish, and more mixed with black streaks; rest of under parts more heavily streaked with black; gray central shaft-streaks of the feathers of the upper parts narrower and less speckled with black centrally.

***Phasianus colchicus suehschanensis* Bianchi**

1 ad. ♂, Nov. 10, La Pei, Cheng Gou Creek (6000 ft.); and 4 ad. ♂, Nov. 4, 7, and 10, and Dec. 5, Cheng Wei, Cheng Gou Creek (6000 ft.).

A small series collected at Cheng Wei, Cheng Gou Creek, 25 miles west of Wenchwan, represents an interesting locality for this form, which was described from Sungpan. The specimens collected in November and December are in perfect fresh plumage and differ from two worn birds from the type locality (Sungpan) as follows: crown more glossed with purple; feathers of upper parts very much more glossed with bronze-green; basal areas of central rump-feathers bronze-green, not bluish green; long lower rump-feathers and edges of central rump-feathers buffy glossed with bronze-green, not gray glossed with bluish green. These differences may be due to plumage condition.

***Picoides tridactyla funebris* Verreaux**

1 ad. ♂, Dec. 10, Cheng Gou Creek; and 1 ad. ♀, Nov. 19, Mao Mo Gou.

The white markings are somewhat more extensive throughout in the two Carter-Sage birds than in a single specimen from the Lichiang Range, particularly on the lower belly and flanks, where the spots merge to form distinct, interrupted white crossbars, and on the wings. However, on examining large series of *P. t. funebris* from various parts of Yunnan and western Szechuan from the Museum of Comparative Zoölogy at Cambridge, the Philadelphia Academy of Sciences, the Smithsonian Museum at Washington, and the Field Museum at Chicago, I find that these differences are merely due to individual variation.

***Dryocopus martius reichenowi* Kothe**

2 ad. ♂, Nov. 8 and 10, Cheng Wei, Cheng Gou Creek.

The question of races of this species is still open (see Hartert and Steinbacher, Erg. V. p. F., p. 377). The two Sage birds are very deep black and are large (wing, 2 ♂ ad., 249, 251), but with very short bills.

Two Yunnan birds are equally black and have the broadest bills in our entire series.

Pycnonotus sinensis sinensis (Gmelin)

1 ad. ♀, Chengtu. This locality near the border of the range of the species seems worth recording.

Troglodytes troglodytes szetschuanus Hartert

2 ad. ♂, Nov. 9 and 15, Cheng Gou Creek; 1 unsexed specimen, Nov. 30, Cheng Gou Forks, and 1 ad. ♂, Nov. 21, Mao Mo Gou.

Since it has been frequently questioned whether there were any valid differences between *szetschuanus* (northwestern Szetchuan) and *tali-fuensis* (Yunnan), it might be valuable to describe these differences:

Troglodytes troglodytes tali-fuensis Sharpe.—General color above dark, tinged with rufous even on the crown; dark bars of lower back usually less complete, forming less continuous bars, and more or less obscured on lower back. Below light buff, incompletely barred. Six specimens examined.

Troglodytes troglodytes szetschuanus Hartert.—General color above dark and much more olivaceous, less tinged with rufous; crown olivaceous brown, not dark rufous brown. Barring more complete and extensive on upper back. Below much darker, grayer, and more extensively and heavily barred. No difference in size. Six specimens examined.

Tarsiger chrysaeus vitellinus Stresemann

1 ad. ♀, Oct. 3, Chen Liang Shan Range.

My material shows no differences between the males of *vitellinus* and *chrysaeus*. Females, however, in fresh autumn plumage from Yunnan, Szetchuan, and the Tsinling Mts. are paler yellow, less orange-yellow below, and more greenish olivaceous, less orange-olivaceous above than Sikkim females in the corresponding plumage, though a large series of Tsinling Mts. females in worn spring plumage approaches them in color. Apparently the general color of the plumage of the upper parts and especially of the tail becomes more orange with wear, and the olivaceous edges of the feathers at the side of the breast wear off.

Tarsiger indicus yunnanensis Rothschild

1 ad. ♂, Nov. 9, Cheng Wei, Cheng Gou Creek.

It seems to be interesting to record this occurrence of this rare species.

Phoenicurus aureus aureus Pallas

1 ad. ♂, Dec. 23-25, Chengtu.

There is a considerable amount of variation in this species, and the extensive migrations of the northern populations make it difficult to work out the characters of the various races.

The measurements of sixty-four adult males from the entire eastern range show that there are no differences in size but there seem to be differences in coloration. Males in fresh plumage from Japan and the vicinity of Vladivostok differ from a series from the Tsinling Mts. in comparable plumage by having crown and nape somewhat less blue-gray and by having the feathers of crown, nape, and back usually edged with more brown.

Phoenicurus a. leucoptera can probably be accepted for the Yunnan birds and the migrants farther south (Burma, etc.). The black gorget of these specimens is more extensive and of a deeper and glossier black. The feathers of the back have no or only narrow brown edges; the gray of crown and nape is darker and the feathers show little or no brown edging when fresh. In worn condition only the nape shows some whitish, the crown remaining gray to the end of the breeding season. The under parts are deeper, more rufous, less buffy than in *P. a. aureus*. Females of *leucoptera* differ from those of *aureus* in being slightly more olivaceous, less rufous above, and slightly darker and less yellowish below, especially on breast and throat.

Phoenicurus frontalis sinae Hartert

5 adult ♂, Cheng Wei, Oct. 27, Nov. 3, 4, 6, and 7, and 6 adult ♀, Nov. 2, 4, 6, 7, 9, and 17, Cheng Gou Creek, Cheng Wei.

Material of a hundred and ten specimens shows that birds from the Tsinling Mts. are distinctly lighter red than birds from the Himalayas. The blue parts are lighter and more greenish and the orange-brown parts are also distinctly lighter; specimens from Szechuan are somewhat intermediate.

Turdus merula subspecies

1 specimen (no date, but probably Dec.), Chengtu.

The measurements (wing, 154; tail, 111) of the single adult male agree with those of a considerable series (64 specimens) of *Turdus merula mandarinus* Bonaparte. The coloration, however, is quite different. It is much blacker, and the brown edges of the feathers of the throat are much less conspicuous. The remainder of the under parts is very much darker. This specimen appears to be intermediate between *mandarinus* and *intermedius*.

Grandala coelicolor Hodgson

4 ad. ♂ and 1 imm. ♂, Nov. 26, Cheng Gou Forks, and 5 ad. ♂, Dec. 7, and 5 ad. ♂, Dec. 10, Cheng Wei, Cheng Gou Creek.

A splendid series of fourteen males overlaps in its measurements (wing 14 ♂ adult, 140–147 (144.0)) so much with Sikkim birds (Journ. Bombay Nat. Hist. Soc., XXXVI, 1934, p. 358) that it seems unwise to recognize *florentes* Bangs.

Garrulax cineracea cinereiceps Styan

3 ad. ♂, Nov. 2 and 8, and Dec. 8; and 3 ad. ♀, Nov. 8, 9, and 10, Cheng Wei, Cheng Gou Creek; and 1 ad. ♂, Nov. 20, Mao Mo Gou.

There has been some argument about the correct name of this subspecies. La Touche ('Birds of Eastern China,' I, p. 61) believes that the name *cinereiceps* refers to the black-headed subspecies with the buffy superciliary, ear-coverts, and sides of the head. Bangs (1932, Field Mus., Zool. Ser., XVIII, p. 355) has emphasized, however, that both description and plate of *cinereiceps* refer to the gray-headed subspecies (hence the name) with rufous on the sides of the head, the form to which this name has always been applied (see also Greenway, M. C. Z. Bull. 74, p. 132). The fact that we have a juvenile which moults directly from the rufous-headed plumage into the black-headed is additional proof against La Touche's theory that the gray-headed birds are immature, and that *styani* has a gray-headed immature plumage.

A detailed description of the two races reads as follows:

Garrulax cineracea cinereiceps.—Crown and nape gray or gray with blackish centers to the feathers, sometimes olivaceous or olivaceous with blackish centers to the feathers, rather variable. Patch in front of the eye, short stripe above the middle of the eye, cheeks, and forward part of ear-coverts white or whitish; superciliary stripe broadening posteriorly and shading into olivaceous on sides of neck, posterior part of ear-coverts and sometimes the basal part of the feathers of the malar stripe more or less bright rufous; black postocular stripe short and inconspicuous; breast vinaceous buff; belly orange-buff, darker, and more olivaceous on the flanks, deeper and brighter on the thighs and crissum; upper parts olive-colored, variable but usually tinged rather rufous.

Garrulax cineracea styani.—Crown black (except in juvenile plumage, when it is the same rufous-olive color as the back), the black extending backward to the upper mantle, where it forms an irregular patch in six of a series of nine birds from northwest Yunnan and ending on the nape in two birds from Tsekou, Yunnan, and one from Ta-tsien-lu, southwest Szechuan. Rufous of superciliary line and ear-coverts lighter, more olivaceous, and shading more gradually into the white of the region below and in front of the eye, which is grayer, less pure white; black postocular stripe longer and more noticeable, frequently extending backward as far as the back of the ear-coverts; under parts lighter; breast a much lighter, not so

vinaceous buff; belly, flanks, thighs, and crissum all lighter and less tinged with orange; back averaging more olivaceous, less rufous, than in *G. c. cinereiceps*.

Garrulax lunulata (Verreaux)

1 ad. ♂, Nov. 20, Mao Mo Gou; and 2 ad. ♂, Nov. 8, and Dec. 8; and 2 ad. ♀, Dec. 8 and 9, Cheng Wei, Cheng Gou Creek.

It might be interesting to record the localities at which these specimens were collected.

Garrulax elliotii elliotii Verreaux

4 unsexed specimens, Oct. 24, Tsao Po; 2 ad. ♂, Nov. 1, 1 ad. ♂, Nov. 13, 1 ad. ♂, Dec. 5, and 1 ad. ♀ (no date), Cheng Wei, Cheng Gou Creek; and 1 ad. ♂, Dec. 1, 1 ad. ♂, Dec. 3, 2 ad. ♀, Nov. 27, 1 ad. ♀, Dec. 1, 1 ad. ♀, Dec. 3, 2 ad. ♀, Dec. 4, and 1 unsexed specimen, Nov. 28, Cheng Gou Forks.

Seven males from Szetchuan measure: wing 91–101 (95.2), tail 122–132 (126.1), while two males from Kansu are larger, wing 104.5, 106.5 (105.5) and tail 140, 146.5 (143.2). I agree with Riley that *G. e. prjevalskii* is a valid race (Riley, 1930, Proc. U. S. Nat. Mus., No. 2838, p. 24).

Pteruthius xanthochloris pallidus (David)

1 ad. ♂, Nov. 29, Cheng Gou Forks.

The Carter-Sage bird is *Pteruthius xanthochloris pallidus*, but differs from eight other specimens of that race as follows: gray of nape cut off more definitely above the upper mantle, not extending down into it and fading gradually into the olive of the back; back a brighter olive, less pale grayish; and bill narrower, although that may be because it was tied up tightly with string. These points of difference may be individual variation.

Material Examined.—*P. x. xanthochloris*: 3 ad., Sikkim. *P. x. pallidus*: 1 ad. ♂ and 1 ad. ♀, Kwanhsien, middle Min Ho, Szetchuan; 1 ad. ♂, Lichiang Range, N. W. Yunnan; 1 ad. ♂, Mekong-Salwin Divide, 10,000–11,000 feet; and 2 ad. ♀, Mekong-Salwin Divide, 7000–9000 feet and 8000–10,000 feet.

Fulvetta chrysotis swinhoii (Verreaux)

1 ad. ♂, Nov. 30, Mao Mo Gou; and 2 ad. ♂, Dec. 2 and 4, Cheng Gou Forks.

Rothschild (1926, Bull. Brit. Orn. Club, XLVI, p. 64), when describing *F. c. forresti*, said that it was a deeper yellow than *F. c. swinhoii*. However, he was comparing fresh specimens (Forrest, 1919) with two

older ones (Weigold, 1915). The newly collected Carter-Sage birds, from the same region as the pale Weigold specimens, are brighter than any others of the species. This species seems extensively given to fading, as is proved by the series before me, where the newest specimens are the brightest and the oldest, the palest. The true differences between *swinhoii* and *forresti* are:

F. c. swinhoii, Szetchuan.—No yellow eye-ring; throat patch uniform dark slaty gray extending down on breast.

F. c. forresti, N. W. Yunnan.—Yellow eye-ring sometimes small and sometimes lacking; throat patch lighter gray, occupying only the throat, not extending onto the breast.

Alcippe cinereiceps cinereiceps (Verreaux)

1 ad. ♂, Nov. 9, 1 ad. ♂, Nov. 11, 2 ad. ♂, Dec. 5, 1 ad. ♂, Dec. 8, and 1 ad. ♀, Dec. 5, Cheng Wei, Cheng Gou Creek; 4 ad. ♂, Nov. 27, 28, 29, and 30, 3 ad. ♂, Dec. 1, 1 ad. ♀, Nov. 28, 2 ad. ♀, Dec. 2, and 1 ad. ♀, Dec. 4, Cheng Gou Forks.

These localities of the rare species are of interest.

Yuhina diademata diademata Verreaux

1 ad. ♂, Oct. 28, 1 ad. ♂, Nov. 6, 1 ad. ♀, Nov. 11, and 1 unsexed specimen, Nov. 6, Cheng Wei, Cheng Gou Creek; and 1 ad. ♂, Dec. 2, Cheng Gou Forks.

Specimens of this species are apt to fade very rapidly. The Carter-Sage birds are considerably darker than sixty other specimens that were collected earlier. The type and a paratype of *Yuhina diademata obscura* Delacour and Jabouille, from Tonkin, are in no respect different from any of the Yunnan or Szetchuan specimens.

Lanius schach schach Linné

1 ad. ♀ and 1 ad. unsexed specimen, Dec. 23-25, Chengtu.

During the comparison of the Sage specimens with our material, I found that Hainan Island is inhabited by an undescribed race.

Lanius schach hainanus, new subspecies

TYPE.—No. 450989, Amer. Mus. Nat. Hist. (Rothschild Collection); ♂ ad.; Hainan Is.; February 14, 1902; Katsumata coll.

Similar to *L. s. formosae* Swinhoe, but much smaller and possibly slightly paler; differs from *schach* by the same characters as *formosae*; under parts white, not suffused with pinkish buff; base of lower mandible in adult specimens always black; usually more gray on the upper back, more black on the forehead, and more black on the outer tail-feathers.

L. s. hainanus.—Wing, 8 ♂ ad. 98–103 (100.9), 5 ♀ ad. 98–101 (99.8); tail, 8 ♂ ad. 122–129 (125.5), 5 ♀ ad. 118–126 (121.8).

L. s. formosae.—Wing, 13 ♂ ad. 103–109 (105.4), 8 ♀ ad. 100–105 (102.5); tail, 13 ♂ ad. 129–138 (134.5), 8 ♀ ad. 124–132 (128.1).

Urocissa erythrorhyncha brevixilla Swinhoe

1 ad. ♂, Nov. 10, Cheng Wei, Cheng Gou Creek.

My material shows that three subspecies have to be recognized in China:

(1) *Urocissa erythrorhyncha brevixilla* (type locality: Hills west of Peking) northeastern Szechuan, the Tsinling Mts., and the province of Chili. Upper parts of body and tail paler than in *erythrorhyncha* with less of a bluish tinge and that of a more purplish shade. Back appearing more grayish, less bluish. Light bluish-gray patch on nape averaging broader, though this may be due to the preparation. Males, wing 187–194; females, wing 184.5–189. 27 specimens examined.

(2) *U. e. erythrorhyncha* (type locality hereby restricted to Canton, South China). Eastern China from the Yangtze southward and eastward to Mengtze, southwestern Yunnan, and northern Annam. Upper parts averaging darker, more tinged with purplish blue; light bluish-gray patch on nape averaging narrower. The white tips of the innermost secondaries average narrower in this and the next race than in *U. e. brevixilla*. Some individuals have the tail a brighter, truer, and less purplish blue. Males, wing 170–194, tail 341–408; females, wing 173–193.5, tail 298–423. 69 specimens examined.

(3) *Urocissa erythrorhyncha caerulea*, new subspecies

TYPE.—No. 450991, Amer. Mus. Nat. Hist. (Rothschild Collection); ♂ ad.; Lichiang Range, N. W. Yunnan; October, 1918; George Forrest.

Similar to *U. e. erythrorhyncha*, but upper parts lighter and considerably more bluish, tail of a brighter, purer, and less purplish blue; light bluish-gray patch on nape extensive and more bluish, less whitish; size larger.

7 ♂, wing 202–211 (205.0), tail 406–463 (436.3); 4 ♀, wing 190–205 (198.5), tail 388–416 (398.0).

RANGE.—Lichiang Range, Tengyueh Valley, Shweli-Salwin Divide, western and northwestern Yunnan. 18 specimens examined.

Two males from the Shweli Valley agree with *caerulea* in coloration, but are considerably smaller (wing 184, 187).

Aegithaliscus bonvaloti bonvaloti Oustalet

1 ad. ♂, Nov. 28, and 2 ad. ♂, Dec. 4, Cheng Gou Forks.

The birds that are now combined under the name *Aegithaliscus bonvaloti* form a link between the species *Aegithaliscus fuliginosus* and *A. iouschistos*. The Carter-Sage specimens from Cheng Gou Forks, near Wenchwan, show a definite approach toward *A. fuliginosus*, but possibly not quite as pronounced as a specimen described by Kleinschmidt

and Weigold. The breast-band is dark olivaceous brown, darker than in typical *A. bonvaloti* and without any tinge of reddish brown, but not as dark as in *A. fuliginosus* and not chocolate brown. The flanks are much paler and more pinkish, less rufous, than in the typical birds and are almost identical in color with those of *A. fuliginosus* except that they are a slightly warmer pink, and the thighs are the same color, not chocolate brown, as in *A. fuliginosus*. The throat patch is more silvery gray, as in *A. fuliginosus*, less blackish, as in the typical birds, and in two of the specimens there is a silvery gray sheen on some of the small feathers about the eye, showing an approach to *A. fuliginosus*, which has the whole side of the face silvery gray. The rest of the upper parts is as in typical *A. bonvaloti* except that the light brown of the rear part of the ear-coverts, of the upper edge of the mantle, and of the occipital part of the light crown stripe is slightly duller and darker. I have seen typical specimens of this species from Mupin, Hsingaitse, and Hokow. Two old birds, supposedly from "Ta-tsien-lu" but without exact date and locality, agree much better with a series from Yunnan and southwest Szetchuan, which differs slightly from the typical series by the following characters: breast-band broader, less well defined, and lighter than in typical *A. bonvaloti*, nearly the same color as the flanks but more yellowish. Rufous areas of flanks much more extensive, having a narrower white area in the middle of the belly. Light brown of the rear part of the ear-coverts, of upper edge of mantle, and of the occipital part of the light crown stripe lighter and brighter, being rufous buff, not light brown. Back and mantle frequently gray or grayish, not grayish brown. In most of these characters these birds tend to approach *A. iouschistos*, which, however, I do not think is very closely related to them, despite its similar markings, as it is much smaller and has the white areas of the head replaced by bright buff.

Cholornis paradoxa Verreaux

1 ad. ♀, Nov. 10, Cheng Wei, Cheng Gou Creek.

Two birds from northern Szetchuan are indistinguishable from two Kansu specimens. A single specimen in worn plumage from the Tsinling Mts., Shensi, is, however, so different, that it seems worth while to describe the differences. More material from the Tsinling Mts. is needed before a new race can be named. Some of the difference may also have been accentuated by wear.

Cholornis paradoxa subspecies, Tsinling Mts., S. Shensi.—Similar to *Cholornis paradoxa paradoxa*, but crown lighter and more grayish, less vinaceous; dark super-

ciliary line a cooler, more olivaceous shade of brown; mantle, back, rump, and upper tail-coverts grayer and with less of a yellowish-olivaceous tinge; wings and tail gray, not grayish brown; breast, crissum, and middle of belly very much grayer, less tinged with vinaceous, the middle of the belly being very much lighter, almost whitish; and flanks olivaceous gray, not yellowish or olivaceous brown.

Suthora fulvifrons cyanophrys David

1 ad. ♀, Nov. 23, and 2 ad. ♀, Nov. 24, Mao Mo Gou.

These three specimens of this rare species are highly welcome, since they were collected nearer to the type locality of this form than any other specimen and since the original pair was collected in southwest Shensi. These three birds agree perfectly with the description and with the plate (No. 66) in David and Oustalet's 'Oiseaux de Chine.'

All the other specimens which were collected in recent years in southwestern Szechuan and Yunnan and which had been identified as *S. f. cyanophrys* David belong to an unrecognized race which might be described as follows:

Suthora fulvifrons albifacies Mayr and Birkhead, new subspecies

TYPE.—No. 450990, Amer. Mus. Nat. Hist. (Rothschild Collection); ♀ ad.; Lichiang Range, Yunnan (11,000 ft.); December 12, 1921; George Forrest coll.

Similar to *cyanophrys*, but duller; the joining of the blue-gray stripes at the nape much less conspicuous; circumocular region, cheeks, parts of ear-coverts, and a broad stripe on the sides of the neck whitish, not rich ochraceous as in *cyanophrys*; back duller and grayer, lacking the bright mustard color of *cyanophrys*; edgings of secondaries and tail-feathers deeper, more rufous; size similar. 24 specimens from N. W. Yunnan examined.

Emberiza cia subspecies

1 ad. ♂, Oct. 1, Cheng Liang Shan Range; 4 ♂, Nov. 1, 2, 10, and Dec. 6, and 1 ad. ♀, Nov. 3, Cheng Gou Creek, Cheng Wei; 1 ♂, Dec. 11, Tsao Po.

The geographical variation of this species is still insufficiently understood, in spite of all the work done in recent years. I do not want to add any more names to the many that have been proposed already and content myself in describing the various populations which I can differentiate in the collections of the American Museum. The descriptions of the four West China populations are as follows:

Emberiza cia subspecies 1.—W. Szechuan (Ta-t sien-lu north to the vicinity of Wenchwan). Black streaks on back and black centers of greater wing-coverts, innermost secondaries and central rectrices velvety black, the black streaks on the back being moderately broad; rufous markings on head very indefinite and much mixed with gray, giving a pale effect. In females and young birds the crown is definitely striped with narrow black streaks. Rump and upper tail-coverts buffy

rufous, the feathers of the rump edged paler rufous, and those of the upper tail-coverts edged light buff and sometimes showing a little blackish along the shaft; borders of wing feathers and of central rectrices light rufous, edged outwardly with pale buff; chin, throat, breast, and sides of neck pale blue-gray; and under parts buff, palest on middle of belly and deepest and most rufous near the edge of the gray breast. Males, wing 73.5–83.5; female, wing 78. 9 specimens examined.

Emberiza cia omissa.—Tsinling Mts., S. Shensi. Black streaks on back and black centers of greater wing-coverts, innermost secondaries, and central rectrices much narrower and a duller and rustier black than in *E. c.* subsp. 1, the black streaks on the back being much less definite, as well as much narrower; mantle a much warmer color, pale rufous-buff, not cool buff; rufous markings on head as in *E. c.* subsp. 1, but more sandy-colored and more mixed with buff than with gray; narrow black streaking on the crown in the females and young blackish brown, not pure black, and very indefinite and inconspicuous; rump and upper tail-coverts as in *E. c.* subsp. 1, but buff edgings of upper tail-coverts less pale, more rufous; borders of wing feathers and central rectrices broader and more rufous with the buff outer edging less pale, more rufous; chin, throat, breast, and sides of neck as in *E. c.* subsp. 1; and under parts also as in *E. c.* subsp. 1, but they average perhaps a trifle darker and more rufous, less yellowish. Males, wing 77.5–82.5; females, wing 72.5–82.5. 9 specimens examined.

Emberiza cia yunnanensis.—Lichiang Range, N. W. Yunnan. Black streaks on back and black centers of greater wing-coverts, innermost secondaries, and central rectrices deep velvety black, as in *E. c.* subsp. 1, the streaks on the mantle being broad and heavy; color of mantle much darker and more rufous than of the two preceding populations; rufous markings on head very dark, solid, and well defined and more extensive than in either of the two preceding populations or the one following; crown striped narrowly with black in the females and immature birds; rump light, bright rufous; the upper tail-coverts only occasionally edged with buff and sometimes showing blackish shaft-streaks; borders of wing-feathers and of central rectrices narrower, the rufous being deeper and brighter, and the buff outer edge narrower; chin, throat, breast, and sides of neck as in *E. c.* subsp. 1; middle of belly buff, and the rest of the under parts pale buffy-rufous, deepest on the flanks and near the edge of the gray breast. Averages a very little larger than either of the two preceding populations. Males, wing 80–85; females, wing 75.5–79.5. 16 specimens examined.

Emberiza cia subspecies 2.—Wanhsien, S. E. Szetchuan. Markings of crown as in *E. c. yunnanensis*, dark, solid, and well defined, but a trifle less extensive; upper parts, wings, and tail about as in *E. c. yunnanensis*, but not as much suffused with rufous throughout; gray of chin, throat, breast, and sides of neck a trifle darker and "bluer" than in *E. c. yunnanensis*; and under parts about intermediate between *E. c. yunnanensis* and *E. c. omissa* or *E. c.* subsp. 1. A much smaller bird than *E. c. yunnanensis* and slightly smaller than the other two races above mentioned. Males, wing 78–81; female, wing 75. 4 specimens examined.

Passer rutilans rutilans (Temminck)

2 ad. ♂ and 1 ad. ♀, Dec. 23–25, 1934, Chengtu.

It is questionable whether or not Chinese birds should be included

with typical *rutilans*. They do not possess (in fresh plumage!) the broad conspicuous buff edges on the feathers of the upper parts; the edges are much narrower and usually only on the upper mantle and rump, while crown and nape are usually uniform rufous.

[Concluded June 15, 1937.]

AMERICAN MUSEUM NOVITATES

Number 967

Published by
THE AMERICAN MUSEUM OF NATURAL HISTORY
New York City

Dec. 4, 1937

NOTES ON CARANGIN FISHES

By J. T. NICHOLS

I.—ON YOUNG *CARANX HIPPOS* (LINNAEUS)

Species of the genus *Caranx* show certain changes with age which frequently lead to misidentification of even our familiar local species. This is particularly the case because these changes, probably for the most part parallel in the different species, vary with each species as to extent or size at which they take place. I therefore have it in mind to record them as opportunity offers with the idea of making helpful that which is confusing in our present stage of recorded knowledge of the subject.

Through the courtesy of Mr. E. Milby Burton, Director, ten specimens of young *Caranx hippos* from South Carolina in the collection of the Charleston Museum have been loaned to me for study. They were taken in 1931 to 1934, between June 30 and September 25, and measure from 23 to 65 mm. in standard length.

The most obvious proportional differences between these specimens and the adult are that they are deeper and more compressed, depth in standard length, 1.9 to 2.6 versus 2.8 to 3; head, 2.8 to 3.1 versus 3.5 to 3.7; eye in head, 2.8 to 3.5 versus 5; the front of second dorsal and anal are lower, and pectoral less falcate, shorter than versus equal to or longer than head. The chord of the curve of lateral line, in the straight part, varies from 1.1 to 1.3; and 20 to 29 scutes can be counted, somewhat less than in the adult.

The largest of the eight specimens, that of 65 mm. standard length, would be recognized off-hand as a *Caranx hippos*. It is large enough so that the characteristic form of head and body, dentition, naked breast with patch of small scales before the ventrals and fin counts are easily appreciable, and in it the front of the soft vertical fins are moderately elevated; the color very like that of the adult except that there is no dark mark on the pectoral base. The smallest specimens are quite different, and due to this and their small size could scarcely be identified with certainty except in series.

The slight change of depth of body in the size range of the ten is com-

plicated by individual variation. Two specimens of 23 to 25 mm. have the depth 1.9 to 2.1; 3 of 31 to 33 mm., 2.2 to 2.4; 4 of 37 to 50 mm., 2.4 to 2.6; one of 65 mm., 2.6.

The lengthening of the pectoral and front of the soft vertical fins progresses more evenly. The pectoral is bluntly pointed in 5 specimens of 23 to 33 mm., pointed in 3 of 37 to 40 mm., falcate in 2 of 50 to 65 mm. It is 1.5 to 1.7 in head in 5 of 23 to 33 mm.; 1.3 in one of 37 mm.; 1.4 in one of 39 mm.; and 1.2 in 3 of 40 to 65 mm. Soft dorsal and anal are not or just appreciably elevated in front in 6 of 23 to 37 mm.; slightly elevated in one of 39 mm., slightly more so in one of 50 mm., and moderately elevated in one of 65 mm.

In 2 of 23 to 25 mm. scales are barely appreciable on sides. The scaleless breast is appreciable from 31 mm. up; its patch of scales not appreciable in 3 of 31 to 33 mm.; more evident in one of 37 mm. than in three of 39 to 50 mm. but scarcely appreciable in these 4; very evident in one of 65 mm.

The two smallest specimens of 23 and 25 mm. have conspicuous dark cross-bands, a curved band through the eye, short band on upper part of opercle, and 5 on the body, these last as broad or broader than interspaces above and narrower or faint in the silver below; spinous dorsal more or less dusky. In 4 specimens of 31 to 37 mm. this banded color pattern is conspicuous and consistent, perhaps more bold in the smaller of these. There are 5 dark bands on the body about as broad as the interspaces, also a band diagonally back from top of eye and down below it, one across the border of the opercle, and the peduncle at base of caudal is dark. The spinous dorsal is blackish and there is sometimes a trace of dusky on the front angle of the soft dorsal. One of 39 mm. is the same but the opercular band more confined to the upper angle of the opercle; and one of 40 mm. is like it, but with the spinous dorsal merely dusky as is also the lobe of the soft dorsal; in one of 50 mm. the band through eye and 5 on body are present but faint, the opercular band is present on the back, but the opercle has merely a restricted dusky blotch on its upper angle, spinous dorsal and lobe of soft dorsal are slightly dusky; one of 65 mm. retains only faint traces of 5 dark cross-bands on the body; its spinous dorsal, and soft dorsal lobe are slightly dusky, and there is a conspicuous blackish blotch on the upper angle of the opercle. The juvenal color pattern then holds between 20 and 40 mm., is fading between 40 and 50, and only slight traces of it remain at 65. The juvenal pattern is not always so well marked as in this South Carolina material. Two specimens of 31 and 36 mm. from Moriches Bay, Long

Island, July 26, 1934, are silvery, bands only faintly indicated, spinous dorsal blackish.

There are no data to hand as to the age of these individuals, where they were spawned, or their rate of growth. They may have drifted for some distance or have been spawned nearby, for adults might be expected to occur in the latitude of Charleston. In 1931, one of 37 mm. was collected Aug. 20, 3 of 39 to 50 mm., Sept. 2, one of 65 mm., Sept. 10; in 1932, 2 of 31 to 33 mm., June 20; in 1933, one of 31 mm., Sept. 25; and in 1934, 2 of 23 to 25 mm., July 19. They are probably spawned in the spring and summer, and grow more rapidly after passing a length of 50 mm., when juvenal drifting habits and color are being replaced by more actively predaceous habits and habitus of the adult. Supposing the 1931 specimens to be more or less one group, it is indicated that this is the case.

Possibly there is a change of life accounting for lack of material below 20 mm., just as there is probably some such change above 50 mm.

Unfortunately there is no *Caranx latus* material of between 20 and 40 mm. standard length available for comparison with this Charleston Museum series of *Caranx hippos* but we have to hand 6 specimens of from 42 to 67 mm. from various localities. These show the subtle change of form with increase of size that there is in both species, a change not adequately expressed by change of depth or other measurements found. The body becomes less ovate, the soft dorsal and anal bases less oblique, that is the angle between them less.

The 67 mm. specimen from Porto Rico in July is surprisingly like much larger fish in appearance and proportions, except that pectoral and lobes of vertical fins are somewhat shorter. It has a slight dusky blotch along the edge of the upper angle of the opercle, spinous dorsal and end of soft dorsal lobe dusky, no other markings. It has depth in length, 2.5; eye in head, 3; pectoral 1.1. For comparison, 2 specimens from Porto Rico of 103 and 107 mm. have depth, 2.5; eye, 3.3 and 3.5; pectoral, 1. One of 265 mm. from Nassau has depth, $2.6\frac{1}{2}$; eye, 3.7.

Small *latus* lose the greater depth and larger eye less with increasing size than do small *hippos*. Two of 42 mm. standard have depth, 2.3 to 2.5; eye, 3 to 3.1; 2 of 48 and 50 mm. depth, 2.4 to 2.5; eye, 3; of 62 and 67 mm., depth, 2.5; eye, 3 to 3.1. The lengthening of the pectoral and front of the soft vertical fins proceeds much as in that species—at 42 mm. pectoral, 1.3 to 1.5, rather bluntly pointed to pointed; front of soft vertical fins slightly to moderately elevated; at 48 to 50 mm. pectoral, 1.3 to 1.4, slightly falcate to falcate, front of soft vertical fins

moderately elevated; at 62 to 67 mm., pectoral, 1.2 to 1.1, falcate, front of soft vertical fins well elevated. The lengthening of the front of the soft vertical fins seems to be slightly more advanced in *latus*.

The scaling on the breast is easily appreciable in all 6 small *latus* examined, a definite character to separate them from *hippos* down to 42 mm. at least. An even more tangible difference is curve of lateral line in straight part, 1.5 or 1.6—1.1 to 1.3 in *hippos* of comparable size.

A *Caranx latus* of 48 mm. standard length from South Carolina, October 28, 1929, Charleston Museum, has 5 faint dark bands across the body as in *hippos*, but broader, distinctly broader than the pale interspaces, and noticeably lacks the dusky blotch on the opercle. The dark top of its peduncle is produced downward in a slight sixth cross-mark, but this is also the case only in a lesser degree in a *hippos* of 50 mm. The five specimens of from 42 to 62 mm. have faint broad dark cross-bands on the sides more or less distinctly indicated, and it may be that at smaller sizes there is a definite bold pattern comparable to that in this other species, perhaps with the bands broader. In the two specimens of 42 and one of 50 mm. an oblique band can be made out slanting downward and forward to eye, and in one of the former there is also a trace of the same below eye, but unlike *hippos*, this is only slightly less oblique than the part above. In the four from 42 to 50 mm. there is no opercular band or mark. One of 62 mm. has a slight dusky edging at the upper corner of the opercle and 4 bands only on the body, faintly indicated dorsad. The five specimens of from 42 to 62 mm. have the spinous dorsal more or less dusky darkest in front, and in all of these but one of 42 mm., the lobe of soft dorsal is more or less dusky.

On the other hand the American Museum has an excellent series of *Caranx bartholomaei* obtained some years ago by Russell J. Coles at Cape Lookout, N. C. The pattern of this species known to drift in the gulfweed distinguishes it at once off-hand from these others when they are too small to show the elevated front of vertical fins. Nine specimens have been examined from 38 to 70 mm. standard length. They are more bicolored, dark above and pale below, the line of demarcation cutting across the head below the eye, without definite dark cross-bands on the body, the nearest approach to same being dark interspaces between silvery blotches that some have on the flanks; and the ventrals are consistently dusky even in the smallest, instead of consistently pale. There is frequently a more or less distinct dark band from the nape downward and forward through the eye, which, however, is narrower than the similarly placed one in *hippos*, and maintains its general slanting direc-

tion below the eye instead of turning directly downward. The spinous dorsal is consistently blackish in all these specimens, even the largest. Scaling on the breast is appreciable in all but not very obvious in any. The concealing coloration of one 46 mm. long to notch of caudal (about 42 standard) when taken from drifting gulf-weed off the east coast of Florida, by the writer in 1917, was noted as "golden olive with irregular bars of silvery white along the back and belly and spots of the same on side; diffuse dusky bar through eye."

Presumably the differently patterned *hippos* and *latus* do not regularly occur in the weed, but follow bits of drift, or jelly-fish as a "hover," a habit frequently associated with banded color in small fishes.

I have seen no specimens of corresponding sizes of the more slender *Caranx crysos*. The technical character of more numerous gill-rakers should differentiate them at any size. *Caranx latus* seems to be a generalized intermediate in some respects, perhaps a parent form, between *hippos* and *crysos*, and is at times confused with this last; but it has about 16 gillrakers on the lower limb of the first arch, versus 25 or 30 in *crysos*.

II.—ON YOUNG *HEMICARANX AMBLYRHYNCHUS* (CUVIER AND VALENCIENNES)

Eight small specimens of *Hemicaranx* collected by L. L. Mowbray off Miami Beach, Fla., December 27, swimming under medusae were reported on in Copeia, 1922, No. 109, p. 59. They range from 22 to 58 mm. long to base of caudal and increase in depth with size, depth in length, 2.1 in the largest. These specimens have recently been re-examined. The two smallest 22 to 23 mm. long, have the characteristic large black opercular blotch present, and the rather high soft vertical fins dusky grayish, but the dark bands on the body, conspicuous at a larger size, only faintly indicated. Such changes of form and color with increasing size are probably correlated with entering a deep-bodied, banded, drifting life-phase.

There was later opportunity to compare a larger specimen 76 mm. long to base of caudal taken off Stono, S. C., August 12, 1931 (Charleston Museum, No. 31. 190. 11), still in this drifting phase for its depth was still 2.1. It had four faint dark cross-bands on the body and one above the conspicuous black opercular blotch, dorsals and ventrals more or less dusky grayish. Its pectoral was longer, 1.2 versus 1.5 in head, bluntly pointed versus rounded; the caudal well forked, its upper lobe appreciably the longer, instead of but moderately forked.

Recently three additional specimens from Charleston County, South Carolina, corroborating these age changes have been received from E. Milby Burton of the Charleston Museum, one of 73 mm. collected August 12, and two of 92 and 93 mm. to base of caudal, collected August 26, 1936. All have the large black opercular blotch present, and the smallest has four broad dark bands on the sides, wider than the interspaces. Traces of these bands are present in only one of the others, and they presumably fade out at about 80 mm. The pectoral is becoming longer and more falcate with increasing size, pointed and a little shorter than the head in the smaller, more or less falcate and a little longer than the head in the two larger. In the 73 mm. specimen the soft dorsal is high and even, in the 93 mm. specimen the fronts of soft dorsal and anal are slightly elevated. In the smaller specimen the caudal lobes are equal, in the two larger the upper lobe distinctly the longer.

Whereas the bands are developed and lost and the fin form is changing in sizes examined, the body retains its depth. Measurements of 73 and 76 mm. specimens are: depth in standard length, 2.2, 2.1; head, 3.5; eye in head, 3.7, 3.9; curve of lateral line in its straight part, 2.2, 2.4; height of curve in its length, 3; dorsal soft rays, 28, 29; anal, 26, 25; scutes, 49, 43. The 92 and 93 mm. specimens have depth, 2, 2.1; head, 3.7, 3.5; eye, 3.5, 3.6; curve lateral line in straight part, 2.5, 2.4; height of curve in its length, 3, 3.3; dorsal, 27, 28; anal, 26, 24 (est.); scutes, 52, 51. If as supposed *Caranx falcatus* Holbrook (1860, Ichth. S. C., Pl. XIII, fig. 2) is the adult of the same fish, the body later becomes somewhat more slender.

Hemicaranx marginatus Bleeker is closely allied to *H. amblyrhynchus* but seems to be slightly less deep, with slightly larger eye, fewer fin rays, and blacker fins. Two specimens of 79 and 82 mm. standard length examined from the mouth of the Congo have depth, 2.25, 2.4; eye, 3.4, 3.35; dorsal soft rays, 27, 25; anal, 22, 21. On the other hand *Hemicaranx rhomboides* Meek and Hildebrand (1925, 'Fishes of Panama,' Field Mus. Zool. Ser., XV, pt. 2, p. 345, Pl. xxv, fig. 2, Colon) is presumably young *H. amblyrhynchus*, the characters given to differentiate it being those of that fish when young.

AMERICAN MUSEUM NOVITATES

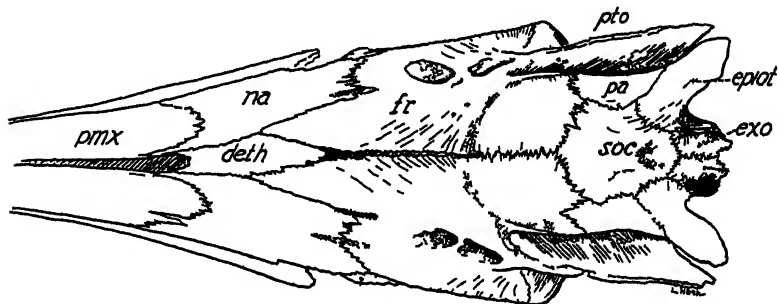
Number 968 Published by
THE AMERICAN MUSEUM OF NATURAL HISTORY December 31, 1937
New York City

THE NASAL BONE AND SWORD OF THE SWORDFISH (*XIPHIAS GLADIUS*)

BY G. MILES CONRAD

The structure of the rostrum which has given its name to the members of that group of giant mackerels, the Xiphiiformes [the swordfishes, spearfishes and marlin-(spike) fishes], has been a persistent puzzle to anatomists since the days of Cuvier and Valenciennes.

Cuvier and Valenciennes (1831), Bruhl (1847) and Regan (1909) have all called the dominant element of the sword the nasal bone. Gregory and Conrad (1937) in a study of the comparative osteology of the swordfish (*Xiphias*) and the sailfish (*Istiophorus*) while differing from previous authors in the homologies of the bones of the sword in the sailfish, agree with them in the case of *Xiphias*.



Istiophorus

Fig. 1 Dorsal view of the skull of *Istiophorus*. After Gregory, 1933, figure 197B.

Regan figures a structural series of scombriform rostra starting with *Acanthocybium*, *Istiophorus*, *Xiphias* and culminating in the Eocene *Xiphiorhynchus*. This figure was copied by Eastman in 1914 in his 'Catalog of the Fossil Fishes in the Carnegie Museum. Part II.' In the case of *Istiophorus*, as implied by Gregory's figure (1933, Fig. 197B), Regan has omitted the very obvious nasal bone from his diagram. Thus in the case of *Istiophorus* the sword is made up exclusively of the

horizontal and ascending rami of the premaxilla, and the element that was originally called nasal is merely the ascending ramus of the premaxilla (Fig. 1).

Gregory and Conrad in considering the formation of the sword in *Xiphias* state (page 18):

There are two possibilities: either the sword may be made up as in the sailfish or it may be made up of other elements and merely parallel that of *Istiophorus*. If the nasals in *Xiphias* have been pushed forward and outward laterally by the forwardly expanding frontals until they are now represented by a mere sliver situated above the narial cavity but covered dorsally by the overhanging frontals, then the elements of the sword may be homologized with those of *Istiophorus*.

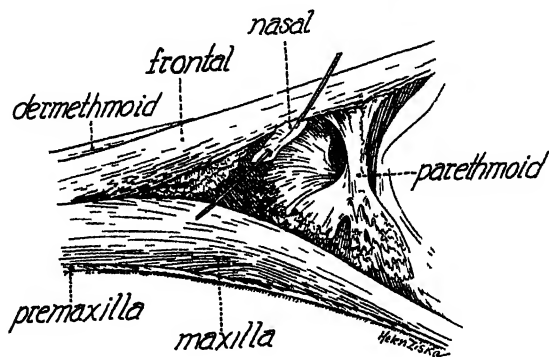
However, because no such element was found they say in a final analysis:

The bone that we identify as nasal retains part of its primitive association with the narial cavity for it enters the cavity anteriorly. There is also no evidence of any other nasal elements. If therefore we are to homologize the elements of the sword with those of the sailfish, we must acknowledge its identity as the nasal. Thus in the sailfish the enlarged nasals form the main part of the broad roof of the skull above the narial cavity and they serve to stiffen the base of the sword on the dorsal surface, whereas in *Xiphias* the narrow nasals have grown forward along with the premaxillae, meeting in the mid-line on the dorsal surface of the sword itself in front of and laterally to the elongate dermethmoid.

On November 5, 1937, only a month after the above statements had appeared in print, Mr. Edgar Greason, Jr., of New York City presented to the American Museum a small, juvenile *Xiphias* with a standard length of 1120 mm. and a weight (eviscerated) of 11½ pounds. Dissection of the narial region of this young swordfish revealed a minute but well-formed bony element lying dorsad to the nasal openings (Fig. 2). There can be no doubt that this element is the true nasal bone, for its position is like that element in *Istiophorus* (Fig. 1). The fact that a tube passes through this bone for the accommodation of the supraorbital canal of the lateral line system seems to be further evidence of its identity as the nasal. Thus the sword of *Xiphias*, and probably *Xiphiorhynchus*, like that of *Istiophorus* consists only of premaxillae, of which the ascending and horizontal rami are severally homologous with those of other scombriforms such as *Acanthocybium* and *Thunnus*.

The rarity of small swordfish and the lack of anatomical notes on the ones known probably accounts for the improper naming of the elements by earlier authors, for it is apparently true that the adult *Xiphias* loses

the nasal, while at the same time the tip of the ascending ramus of the premaxilla encroaches on the nasal region and may easily be mistaken for the posterior end of a forwardly expanded nasal.



Xiphias

Fig. 2. Lateral view of the nasal region of a young *Xiphias*. A bristle has been passed through the supraorbital canal in the nasal bone.

REFERENCES TO LITERATURE

- BRÜHL, C. B. 1847. 'Anfangsgrunde der vergleichenden Anatomie aller Thierklassen.' Erster Abschnitt, 'Die Skelettlehre der Fische.' Lief 1-3. Wien. IV, 254 pp., 19 pls. 4to and obl. folio.
- CUVIER, G., AND VALENCIENNES, A. 1831. 'Histoire naturelle des poissons.' Tome 8°. Paris.
- EASTMAN, C. R. 1914. 'Catalog of fossil fishes in the Carnegie Museum. Part II. Supplement to the catalog of fishes from the Upper Eocene of Monte Bolca.' Mem. Carnegie Mus., VI, No. 5.
- GREGORY, WILLIAM K. 1933. 'Fish skulls: a study of the evolution of natural mechanisms.' Trans. Amer. Philos. Soc. (N.S.) XXIII, No. 2, pp. 75-481, 302 figs.
- GREGORY, WILLIAM K., AND CONRAD, G. MILES. 1937. 'The comparative osteology of the swordfish (*Xiphias*) and the snailfish (*Istiophorus*).' Amer. Mus. Novitates, No. 952, 25 pp.
- REGAN, C. T. 1909. 'On the anatomy and classification of the scombroid fishes.' Ann. Mag. Nat. Hist., (8) III, pp. 66-75.

